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WM. A. ROSENBAUM, Editor Patent Department.
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CONTENTS.

PAGE.

ILLUSTRATED ARTICLES:
Calculations for Long Distance Electric Power Transmission (with table). By L. W. Serrell, Jr. ... 292
Electrical Power Transmission at Virginia City, Nev. ... 293
A Novel Oil Burner ... 295
The Daft "Double Trolley" Road at Cincinnati, O. ... 295
The Topeka, Kan., Rapid Transit Electric Railway ... 296
The Ganz Alternating Machine and Transformer ... 297
The Berlin Electric Light Station ... 298
The Noyes Novel Box Bell ... 299
Expanding Hoops and Tires by Electric Heating ... 299
The Duplex Open Circuit Battery ... 302
A Novel Cigar Lighter ... 302
Martin's Electric Thermocall ... 302

NEW BOOKS:
"Munro and Jamieson's Pocket Book of Electrical Rules and Tables." (Sixth Edition) ... 292
"History of the Transformer." By F. Uppenborn ... 292
"Die Accumulatoren Fuer Elektricitaet." By Edmund Hoppe. 292

CORRESPONDENCE:
Resistance of Platinum Wire. By F. M. T. ... 294
A Correction in Bottone's "Dynamo Building." By W. Elmer, Jr. ... 296
Mr. Nikola Tesla on Alternating Current Motors. By Nikola Tesla ... 297
Dynamo Mishaps. By E. L. Castle ... 299
Cheating the Circuits. By A. Gaillard ... 303

EDITORIAL:
Paragraphs ... 291

MISCELLANEOUS:
The Kind of Dynamo that is Wanted. By H. F. Watts ... 292
Medical Electrolysis ... 294
On Recalescence In Steel and its Relation to Expansion, Magnetization and Hardening. By Prof. Elihu Thomson ... 295
The Perry Method of Measuring High Potentials. By F. L. Perry ... 296
On Quartz as an Insulator ... 298
Determination of Sizes for Inside Wiring on The Two-Wire System, For Beginners. By C. E. Gifford ... 299
Secondary Batteries. By W. H. Preece ... 300
Legislation Affecting Electric Light Interests ... 301
International Congress of Electricians at Paris ... 301
A Lecture Experiment Illustrating the Effect of Heat on the Magnetic Susceptibility of Nickel ... 302
Deaths by Lightning in England and Wales ... 302
The Telephone Amalgamation in England ... 302
Electrical Engineering at Princeton College ... 302
Electricity on War Ships ... 302
American Workmen and the Paris Exposition ... 303

SPECIAL CORRESPONDENCE:
New York Notes, 303; New England Notes, 304; Western Notes ... 304

DEPARTMENTS:
The Telegraph, 304; The Telephone, 304; The Electric Light, 304; Applications of Power, 305; Personals, 305; Miscellaneous Notes, 305; Business Notices ... 305
Our Illustrated Record of Electrical Patents ... 305-6

Recalescence of Steel. FOLLOWING up his note which appeared recently, on the phenomena of recalescence in steel, Prof. Elihu Thomson sends this week a further communication on the same subject, in which he follows out the ideas already expressed, and adds to them a number of other observations. In addition to the bearing these phenomena may have on the construction of pyro-magnetic motors, they also, as Prof. Thomson indicates, have a distinct relation to the tempering of steel, for, as pointed out, the critical temperature of recalescence defines the stages at which the hot steel when suddenly cooled becomes either hard or is annealed. It is to be hoped that Prof. Thomson will find time to continue his researches in this field, and add to our knowledge on so important a subject as the working of steel.

Long Distance Power Transmission. THE electrical engineer in his daily practice is frequently called on to determine the size of conductors required to deliver a certain current a given distance, with a given per cent. of loss. All such will, therefore, be glad to be put in possession of the table calculated by Mr. L. W. Serrell, Jr., which appears on another page. While the table is calculated more particularly for application to the transmission of power electrically, it is evident that it can be with ease applied to other calculations in which current and E. M. F. are involved.

Judges and Electricity. IN the course of the many suits involving questions of priority or novelty of electrical inventions, it has often been remarked that the judges on the bench ought to be assisted by experts independent of either of the parties to a suit, who should advise them on the scientific questions involved It cannot, of course, be expected that judges should be sufficiently well versed in electrical science to form correct opinions on questions involving theoretical and practical considerations. It is, therefore, a high compliment to Judge Coxe, of New York, to find his distinction between a primary battery and a storage battery quoted by Mr. Preece, himself no mean authority, in his recent lecture on storage batteries before the Society of Arts. In regard to this, we have been informed that Judge Coxe pursued a rigid course of study of electricity before giving his decision in the storage battery suit, and he is certainly to be congratulated on the success which has attended his labors.

The Value of An Idea. THE value of little inventions has had a singular proof or manifestation lately in the great run on "Pigs in Clover," a puzzle that has, we venture to say, been seen by nearly all our readers, for it has already made its way everywhere. Mr. C. M. Crandall, the inventor of this toy, says that for twenty years past he has had his mind on the availability of the rolling of marbles for a toy, and that in his model room the first experiment with the "pigs" took the form of a table, two feet in diameter, on a ball and socket joint. This was soon reduced to the hand toy now so familiar, of which 300 gross have been turned out daily for some time, while the demand has not yet been met by the supply. Mr. Crandall is a prolific inventor of toys, but it will be noted that it was twenty years before he evolved this last popular novelty in practical form. His perseverance and his success should give encouragement to other inventors, many of whom are at this very moment working upon new ideas of at least equal worth and utility. In the field of electricity alone, there is room for scores of Crandalls, who in some way or other are to hit the needs and fancies of the public. One does not look for the invention of such great novelties as the telegraph, the telephone, the electric light and the electric motor every day of the week; but electrical improvements and devices, as trivial and as valuable as "pigs in clover," may be arrived at endlessly, and are not to be despised.

Storage Battery Management. ONE is always gratified to read the writings of Mr. William H. Preece, of the British Post Office Telegraphs, and never more so than when he gives the results of his own personal observations. At an early stage Mr. Preece equipped the electric lighting plant in his house with storage batteries charged from a dynamo driven by a gas engine, and the results of his five years' experience with them may be said to be embodied in the instructive lecture which he recently delivered before the Society of Arts, and which we print on another page. Mr. Preece certainly proved, as he has often remarked, that the success of a storage battery plant depends mainly on its management, and that there is nothing in the construction of the storage battery itself which would deprive it of the right to be called a practical device. He does not conceal the fact that as compared with other electrical devices, its rate of depreciation is a high one, but he shows that it has solid claims to be recognized as a valuable adjunct to electric lighting plants. In addition to the many practical hints which he gives, we note the stress which he lays upon the excellent results obtained by adding sulphate of soda to the usual sulphuric acid solution employed in storage batteries. The removal of the old bugbear, the formation of sulphate in the battery, is by this means said to be almost absolutely avoided. We are not aware that this practice is followed to any extent in this country, or even advised by the makers of storage batteries here, but we think that they will do well to give it a trial after the indorsement by Mr. Preece.

An Old Idea in Lighting. WE are again brought face to face with an idea, which is periodically revived, by a correspondent who suggests that the economy of an electric light plant could be largely increased by distributing the current to a number of circuits rapidly, each receiving the current during a short interval of time. He bases his argument principally on the fact that the eye being capable of retaining an impression for a measurable length of time, the absence of light caused by the removal of the current for an instant would not be noticed by it. Leaving out the question of the effect upon the eye of such a light, and presuming that the eye could be cheated in the manner indicated, it remains to inquire whether the circuits could also be cheated in the same way, so as to make a part of the current assume the role of the whole. If to this we add that the electromotive force supplied to a circuit is in the ratio of a mean of the electromotive forces supplied at succeeding intervals of time, the impossibility of obtaining an economy in power by means of this system will be apparent. We fear that our correspondent, though well meaning in his intentions, has not given sufficient thought to the scheme which he proposes for increasing the economy of electric lighting by this means. It might be possible, however, to apply such a system by employing an initial E. M. F. higher than that for which the lamp is intended, but which is made applicable by the lowering of the effective potential due to the short time it is allowed to act upon the lamp. Such a system might effect economy in the *cost of conductors*, but would hardly effect a saving in *power*.

A Crippled Telephone Service. DURING the past week, at a meeting of the New York Board of Trade, one of the members, whose telephone wire had been cut in the recent raids, expressed his opinion of Mayor Grant's tactics and policy pretty plainly, and tried, though unsuccessfully, to get a condemnatory resolution passed. The chances are that had his fellow members suffered in the same way they would have supported him more vigorously. We mention the episode to show that the "unanimity" of popular opinion on the subject is not quite so unanimous as some of the daily papers would make out. There is another point now arising, and that is the payment for this work of destruction. Mayor Grant thinks that the electric companies ought to pay for the destruction of their property, which was established in the thoroughfares under official sanction and guarantee, and he is now seeking for legislation by means of which to drag the money from their pockets. As an exhibition of public morality and of respect for public contracts, this is as pretty a piece as one could wish for. Moreover, the loss to the companies of their poles and wires, for which they are now asked to pay, is but one item in the debit account. In one single case we hear of, it has cost the Telephone Company some five thousand dollars to repair the damage done by the reckless removal of but four poles, which this city paid $5 each for and now seeks to collect on. Now if the telephone people had been contumacious and had refused to have anything to do with the subways, there might be some warrant for this treatment of them—scurvy as it is; but on the contrary they have been active all the time in putting their wires underground, and have done their best to assist in carrying out the provisions of a too-sweeping law. This is their reward. We hope Mayor Grant will not get his.

Electricity in Mining. IT was not long after the electric motor had been demonstrated to be a success that its great utility in mining operations was pointed out; but some time had necessarily to elapse before ideas on the subject could assume tangible form. Recently, however, the question of supplying power in mines has been taken up with vigor by electricians, and the work already accomplished is sufficient guarantee of the great future in store for this application of the motor. As deeds are more convincing than arguments, a reference to the plant described in our columns this week, as installed on the celebrated Comstock Lode, Virginia City, Nevada, must dispel all doubts of the feasibility of this method. The installation described deserves attention not only from the magnitude of the undertaking, but also from the exceedingly novel arrangements employed, which we believe are unique. No greater flexibility of working, or more thorough utilization of power available, could be conceived than the operation of a water-wheel at the surface, the waste water then being led down into the mine nearly 1,700 feet, and there again utilized in driving dynamos which generate current for motors placed beside the first water-wheel on the surface. Not content with this achievement, it is even proposed to still further utilize the waste water from the underground turbines by carrying it to a lower level and there repeating the operation. The electrical engineering profession may indeed be proud of such an achievement, involving as it did not only novel electrical arrangement, but the inauguration of a practice in hydraulic transmission which had heretofore been deemed impracticable. We refer to the use of the enormous pressure of water upon the turbines represented by a fall of nearly 1,700 feet, which we believe is also a feat which has never before been accomplished. The success of this Brush installation will undoubtedly do much for the further success of electricity in its applications to mining purposes, and those who have carried out the work are to be congratulated on the success of their efforts. We may be permitted, perhaps, to express our pleasure at finding a veteran concern like the Brush Company carrying out with so much enterprise and success a scheme that belongs to the very latest developments of electrical application.

NEW BOOKS.

Munro & Jamieson's Pocketbook of Electrical Rules and Tables. Sixth edition, revised and enlarged. New York: D. Van Nostrand Co., 1889. 498 pp. Price, $2.50.

This excellent pocketbook is too well known to need any elaborate review on our part. Those who have been benefited by it will, however, be glad to learn that the fifth edition has been still further increased in value by a thorough revision and by the addition of some 120 pages of new matter and 60 illustrations. Among the new matter we find a chapter by Prof. Sylvanus P. Thompson on the dynamo, in which very simple rules for its construction are laid down; and also an article on transformers, similarly treated by Mr. Gisbert Kapp. There has also been added a description of Sir William Thomson's latest standard balances, Professors Ayrton and Perry's secohmmeter, and a number of other kinds of measuring apparatus and methods for calibrating them. The book is indispensable to all engaged in practical electrical work.

History of the Transformer. By F. Uppenborn. Translated from the German. New York: E. & F. N. Spon, 1889. 60 pp., 5 × 7½ in. Price, 80 cents, paper.

This little work, which gives a history of the transformation of currents from one potential to another, has already been reviewed by us, and therefore needs no extended notice. It embraces the principal results in this department, from the experiments of Faraday to those of the present day, as applied to alternating converter systems, and includes the work of Henry, Page, Ruhmkorff, Bright, Jablochkoff, Gaulard and Gibbs, Zipernowsky, Deri, Blathy and others. The translation is well done, and the volume is illustrated by numerous engravings.

Die Accumulatoren fuer Elektricitaet. By Edmund Hoppe. Berlin: Julius Springer, 1888. 5½ by 8½ in., 234 pp. Price, $2.40, paper.

The literature of the storage battery is one which, though affording room for considerable research, seems to have been sadly neglected, and the dearth of good works on the subject has long been felt. The few books that have appeared in this branch have been restricted in their nature, or when they have attempted to treat the subject generally have been to a certain extent superficial. In the present work, the author has evidently expended a great deal of time and research with a result that the student is given a tolerably complete insight not only into the history, but also the nature of the processes involved in the action, of the storage battery. After a short introduction the author enters into the history of electrolysis and the production of the current in the battery, detailing the various theories of electrolytic action as proposed by Ritter, Davy, Berzelius, de la Rive, Becquerel, Faraday and others, and enumerates the laws which were finally discovered by the latter and which determine the working capacity of the battery. He next takes up the various actions which go on in an electrolytic cell, including polarization and its discovery by Ritter in the original form of secondary battery, and he thoroughly discusses the laws of polarization by the formation of gas, the influence of the electrolytes and the occlusion of the gases in the electrodes.

With this preparatory treatment the author arrives at the actual construction of accumulators as based on the principles before enumerated. Beginning, of course, with the system of Planté, we find recorded the theory of Planté on the action which takes place in the accumulator, and his rules for forming the cell, and are then lead to the consideration of the storage battery as improved by Faure by the application of the active material to the plate in contra-distinction to the forming process.

The author divides the modern forms of storage battery into three divisons. First, those having plates consisting of pure lead, and among which he describes the batteries of Volckmar, Elwell-Parker, Kabath and a number of others. Secondly, storage batteries, in which the active material consists of various salts of lead. Among these we find described the accumulator of Swan, who employs the carbonate of lead; that of Grout, Jones and Sennet, who use carbon; the accumulators of Franklin, Brush, Tribe and a variety of others. Finally, he describes storage batteries whose plates are constructed of various metals and alloys, and thus embodying plates of two different metals. To this chapter we find added a list of the German patents on storage batteries.

The author next takes up the various scientific investigations which have been made on the accumulator, beginning with the chemical investigations of the same, and here we find recorded the experiments of Gladstone and Tribe on the changes which take place in the active material and in the electrolyte during the processes of charging and discharging, and the various views which have been expressed on the subject by a number of authors, among them Aron, Ruehlmann, FitzGerald, Thompson, Salomons and others. The author then proceeds to take up the question of the efficiency of the storage batteries, and here embodies the methods to be pursued in determining the same, and the results of the investigations of various experimenters. To this are added the results obtained in various types of accumulators, including those of the Electric Power Storage Company, Farbaky and Scheneck, Elwell-Parker, Khotinsky, Brush, Lithanode cells and others. The final chapter of the book is devoted to the applications to which the storage battery is adapted, embracing its use for telegraphy and electrotyping, for lighting and motive power purposes, and for the working of metals by electric welding.

Throughout, the work shows the evidence of deep research, and it must be accorded a prominent place in the literature of the storage battery. It possesses an additional value by reason of the many references given by the author to the sources of original information on the subject, and which enable the student to follow out any particular line in which he may be interested, and which in a work of this kind can merely be indicated. The book is illustrated wherever necessary.

Calculations for Long-Distance Electric Power Transmission.

BY LEMUEL W. SERRELL, JR.

In view of the great interest that is being taken in the conversion of water powers into electric energy, and distributing the same for light and power purposes over long distances, a convenient table for calculating the amount of wire necessary to transmit different amounts of power over various distances and under different efficiencies would probably be a welcome help to engineers who have this subject to deal with.

The accompanying table has been calculated for 100 h. p. delivered on the motor shaft. The efficiency of the dynamos and motors is assumed at 90 per cent. The commercial efficiency of transmission equals the mechanical horse-power delivered on the motor shaft, divided by the mechanical horse-power used in driving the dynamos. The dynamo should preferably have a cumulative compound winding, to maintain a constant potential at the motor terminals under varying load.

The size of wire to use in different cases may be determined by reference to any wire table by finding what size or sizes in parallel have circular mils corresponding to the circular mils given in the table.

To find the total weight of copper for any other distance than that given in the table when the efficiency of transmission and the voltage correspond with that given in some of the columns of the table, use the formula,

$$W = T \times \left(\frac{L}{D}\right)^2;$$

where,

W = the required weight of copper.

T = total weight of copper found in last column of table.

L = distance to motor in feet.

D = distance to motor in feet found in table in the same line that T is taken from.

Example:—Required the total weight of copper and the size of wire necessary to transmit sufficient electrical energy to develop 350 h. p. at motors 7,500 feet away under 400 volts pressure at the motor, and 60 per cent. commercial efficiency.

In the third line of the table we find that to develop 100 h. p. at motors 10,000 feet away we need 19,848 pounds of copper at 60 per cent. efficiency of transmission. Therefore, by applying the formula, we have:

W = required weight.

T = 19,848 pounds.

L = 7,500 feet.

D = 10,000 feet.

Therefore, $W = 19{,}848 \times \left(\frac{7{,}500}{10{,}000}\right)^2 = 11{,}164$ pounds of copper required to transmit sufficient electrical energy to develop 100 h. p. in motors 7,500 feet away.

To find the amount of copper necessary for motors developing the required 350 h. p., multiply the total weight of copper required per 100 h. p. by the number of h. p. to be developed, and divide by 100: or we have for 350 h. p.

$$W = \frac{11{,}164 \times 350}{100} = 39{,}074 \text{ pounds,}$$

required to develop 350 h. p. at the motors.

We find from the formula at the top of the table that the circular mils $= \frac{\text{weight of copper per 1,000 ft.}}{.003202}$. Since the total length of the circuit is 7,500 × 2 = 15,000 feet, we have $\frac{39{,}074}{15} = 2{,}605$ pounds weight of copper per 1,000 feet, and the

$$\text{circular mils} = \frac{2{,}605}{.003202} = 813{,}550.$$

Referring to a B. & S. wire table, we find that three 0000, one 000 and one No. 10 wires in parallel give us 812,986 circular mils, having a total resistance of .0192 of an ohm, which would make 139.78 volts drop in the line with 728 ampères, and will bring the voltage of the dynamos up to 539.78 against 540 given in the table.

Efficiency of dynamo and motors assumed at 90 per cent.
Table calculated for 100 H. P. delivered on motor shaft.

$$\text{Circ. mils} = \frac{10581.096}{\text{Resistance of line per 1,000 feet.}}$$

Weight of copper per 1,000 feet = Circ. mils × .003202.

By L. W. Serrell, Jr.

Distance to motor in feet.	Motors. E. M. F. at motor terminals.	Motors. Commercial eff.	Motors. Total H. P. lost in transmission.	Motors. H. P. delivered from motors.	Motors. H. P. supplied to motors.	Motors. Ampères.	Motors. H. P. lost in motors.	Dynamos. Electrical H. P. output from dynamo.	Dynamos. H. P. driving dynamos.	Dynamos. H. P. lost in dynamos.	Dynamos. Voltage of dynamo.	Line. H. P. lost in line.	Line. Total length of wire in line.	Line. Volts drop in line.	Line. Total resistance of line.	Line. Resistance of line per 1,000 feet.	Line. Circular mils in wire.	Line. Weight of copper per 1,000 feet.	Line. Total weight pounds of copper.
2,500	400	70	42.8	100	111.1	208	11.1	128.5	142.8	14.3	463	17.4	5,000	63	.392	.0604	171,870	550.33	2,652
5,000	400	65	53.8	100	111.1	208	11.1	138.4	153.8	15.4	498	27 3	10,000	98	.47	.047	220,900	707.32	7,073
10,000	400	60	66.6	100	111.1	208	11.1	149.9	166.6	16.7	540	28.8	20,000	140	.67	.0335	309,900	992.40	19,848
15,000	400	55	81.8	100	111.1	208	11.1	163.6	181.8	18.2	592	52.5	30,000	192	92	.0306	339,230	1086.21	32,586
5,000	800	70	42.8	100	111.1	104	11.1	128.5	142.8	14.3	925	17.4	10,000	125	1.20	.120	86,509	276.9	2,769
10,000	800	65	53.8	100	111.1	104	11.1	138.4	153.8	15.4	995	27.3	20,000	195	1.88	.094	110,437	353.62	5,072
15,000	800	60	66.6	100	111.1	104	11.1	149.9	166.6	16.7	1,078	38.8	30,000	278	2.68	.089	116,641	373.58	11,207
20,000	800	55	81.8	100	111.1	104	11.1	163.6	181.8	18.2	1,176	52.5	40,000	376	3.62	.090	115,345	370.33	14,813
25,000	800	50	100	100	111.1	104	11.1	180	200	20	1,294	68.9	50,000	494	4.75	.0905	104,708	335.27	16,764
30,000	800	45	122.2	100	111.1	104	11.1	200	222.2	22.2	1,438	88.9	60,000	638	6.13	.1021	101,675	325.56	19,534
5,000	1,200	72	39	100	111.1	69	11.1	125.1	139	13.9	1,350	14	10,000	150	2.19	.219	47,400	151.77	1,518
10,000	1,200	69	45	100	111.1	69	11.1	130.5	145	14.5	1,410	19.4	20,000	210	3.04	.152	68,309	218.72	4,374
15,000	1,200	66	51.5	100	111.1	69	11.1	136.4	151.5	15.1	1,473	25.3	30,000	273	3.96	.132	78,645	251.82	7,755
20,000	1,200	63	60	100	111.1	69	11.1	144	160	16	1,555	32.9	40,000	355	5.15	.128	81,100	259.68	9,797
25,000	1,200	60	66.6	100	111.1	69	11.1	149.9	166.6	16.7	1,620	38.8	50,000	420	6 08	.1216	84,548	270.72	13,536
30,000	1,200	57	75.4	100	111.1	69	11.1	157.8	175.4	17.6	1,695	45.7	60,000	495	7.16	.1193	87,017	278.62	16,717
35,000	1,200	54	85.2	100	111.1	69	11.1	166.7	186.2	18.5	1,800	55.6	70,000	600	8.71	.1244	83,448	267.2	18,704
40,000	1,200	51	96	100	111.1	69	11.1	176.4	196	19.6	1,905	65.3	80,000	705	10.25	.128	82,660	264.67	21,174
45,000	1,200	48	108.3	100	111.1	69	11.1	187.5	208.3	20.8	2,015	76.4	90,000	815	11.97	.133	78,053	249.92	22,493
50,000	1,200	45	122.2	100	111.1	69	11.1	200	222.2	22.2	2,150	88.9	100,000	950	13.93	.139	74,684	239.13	23,913

The Kind of Dynamo That Is Wanted.

BY H. F. WATTS.

Those familiar with the history of electric lighting will remember that at one time the Board of Fire-Underwriters, in the issuance of their regulations, called for an outdoor wire having an insulation that was *fire-proof*, forgetting that an insulation that was *water-proof* was of far greater importance.

The opposite thing seems to have now been carried out in the case of electric motors. The Thomson-Houston and Sprague companies have produced motors which are said to be water-proof and will do their work while a hose is being turned on the commutator, in evident forgetfulness that a motor, or, still better, a dynamo whose armature is *fire-proof* is of enormously greater importance. A condition so abnormal as a bucket of water thrown upon an armature they are ready to meet, but the *burning* out an

armature during the *normal* running of the machine, they are unable to provide against.

The commercial requirements of electric lighting do not call for machines that will run standing out in the rain or under a faucet, but for machines that will run upon the dry floor of a station, and continue to do so without a burn-out year after year, or until the bearings are worn out.

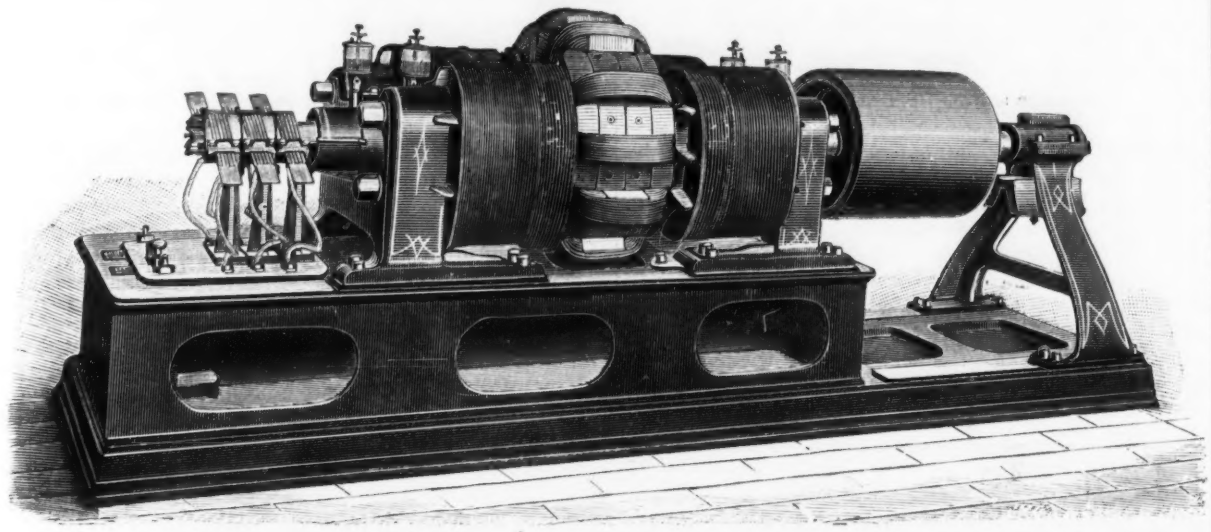


FIG. 2.—BRUSH DYNAMO-ELECTRIC GENERATOR, 130 HORSE-POWER, CHOLLAR MINE.

This machine has never yet been produced, and never will be so long as cotton is used for insulation, and so long as the armature coils are held in place by the binding wires only.

Electrical Power Transmission at Virginia City, Nev.

"More power, economical power," has now for several years been the imperative demand of the owners of mining properties on the celebrated Comstock Lode at Virginia City. The problem has been to work the enormous quantities of low-grade ore at a profit. Large sums have been expended in carrying water from streams in the neighboring Sierra Nevada Mountains for a distance of some thirty miles, to be utilized at the mines and mills on the Comstock. But this supply of water is limited and variable, and by no means meets the demand. Operations have frequently been suspended on this account, causing great loss to the mine-owners and hardship to the laborers dependent upon the active working of the ores.

The best engineering talent of the country has been called to work on this vital problem of power supply, and new arrangements have been made for increasing the amount of water, but vast powers now within reasonable range are still running to waste, which the use of electricity alone can conserve to useful purposes.

At the stamp mill of the Nevada Mill and Mining Company, water power was obtained at the level of the mill from a reservoir on the side of the mountain. The mill contains sixty stamps with their complement of pans, settlers, agitators, rock-breakers, etc. The water power readily available was entirely inadequate for the operation of the mill. The problem was submitted to the Brush Electric Company, through its agents, the California Electric Light Company, of San Francisco. A solution was speedily offered, and the plans were accepted by the owners of the Nevada Mill and Chollar mine. The shaft of the latter is close to the stamp mill. It was proposed to collect the waste water from the surface wheel at the mill, convey it in pipes to the shaft of the Chollar mine, and thence down the shaft until a sufficient head should be obtained to produce the power required. The scheme was novel and presented many difficulties. However, experts pronounced the plans feasible and work was begun last winter.

At the 1,650-foot level of the Chollar mine, a subterranean chamber was excavated out of solid porphyry, for the reception of the dynamo-electric generators and water-wheels. This chamber is 50 feet in length and 25 feet in width and 12 feet in height, clear of all timbers. From the tank containing the waste surface water, two wrought iron pipes are led to the subterranean chamber, one 16 and one 8 inches in diameter. At the bottom of the shaft a Y unites these two pipes into a single one 14 inches in diameter, out of which six 6-inch pipes run to the nozzles of the water-wheels provided to drive the large Brush dynamo-electric generators.

The underground electric station is of the most interesting character and is shown in our illustration, Fig. 2. The large Brush generators, of which there are six, are adapted to the conditions by a few mechanical changes from the standard pattern. They are mounted on a heavy cast-iron base, and are provided with an extended shaft and outer bearing. On each armature shaft and between two bearings, a Pelton water-wheel is mounted and inclosed in a water-tight cover. The illustration of the generator, Fig. 1, was made from a photograph taken at the Brush Electric Company's works at Cleveland before shipment, and shows a pulley on the armature shaft, arranged for testing runs at the factory. The water-wheel is attached to the armature shaft at the place occupied by this pulley, and a coupling is provided for detaching this entire end of the shaft carrying the wheel from the other end carrying the armature.

These Brush generators are each of one hundred and thirty horse power capacity, and are compound wound for constant current. The electrical curve from these machines is almost ideally perfect, and they require no regulator whatever. The current remains of constant strength under all conditions of load.

The head of water at the underground chamber is 1,650 feet. It has never before been attempted to run a water wheel under such enormous pressure. This was, indeed, one of the most serious problems involved in this remarkable installation. From the various excellent forms of water-wheels, the "Pelton" was selected as best adapted to work under the special circumstances. This wheel is the outgrowth of the old hurdy-gurdy form and its buckets are provided with a very ingenious wedge-shaped partition, by which the stream of water is divided and sweeps out through the curved sides in such a way as to produce a reactionary effect in addition to the impact. By the peculiar construction of the buckets all the water is also thrown down and out of the way of the wheel. The six Pelton wheels are each forty inches in diameter, are made of phosphor bronze and weigh 220 pounds. They drive the generators at a speed of 900 revolutions per minute.

The compact arrangement of combined dynamo-generator and water-wheel makes it almost impossible for the visitor to the underground chamber to realize the enormous amount of power here at work. The machines are placed in two parallel rows of three, and the swiftly revolving armatures are all that can be seen in motion as evi-

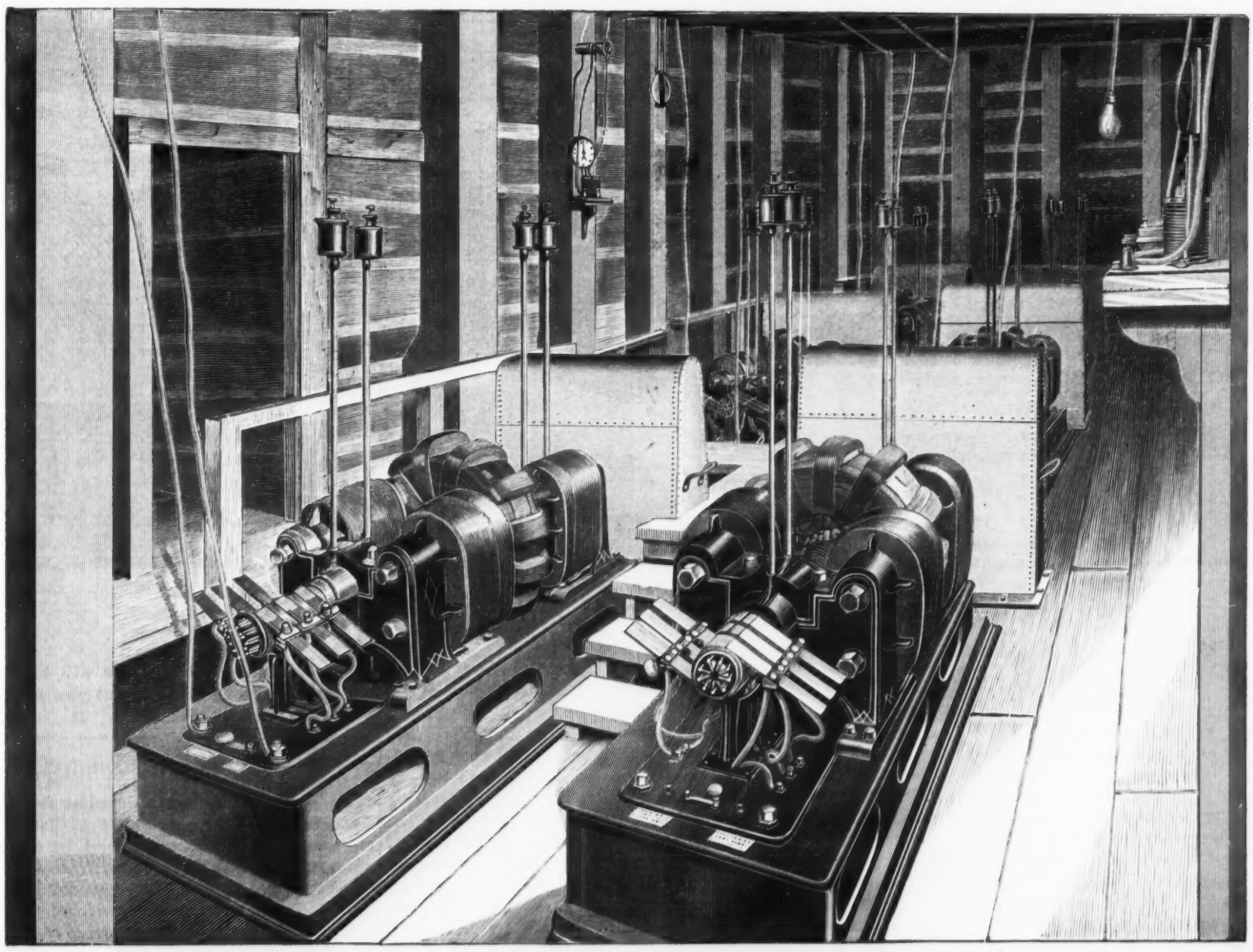


FIG. 1.—UNDERGROUND BRUSH POWER STATION AT THE 1,650 FOOT LEVEL OF THE CHOLLAR MINE.

dence of the 800 horse-power generated. The chamber is brilliantly lighted by 36 Swan incandescence lamps operated in multiple series from one of the generators, and there are several of the same lamps in the incline. Each generator circuit is provided with a dead-beat ammeter of the Brush pattern, and a Brush voltmeter is also at hand which is capable of measuring up to 3,000 volts. The generator circuits are led to a switchboard in the same dynamo-room, where any generator can be thrown on to any one of the outgoing motor circuits.

Leaving this subterranean power station and ascending the Chollar shaft are the circuits of copper wire, one to each generator. At one point these circuit wires pass through a shower-bath of spray, but the insulation is so perfect that no leakage has as yet developed. The wires issue from the mine shaft and are carried above ground to the electric motor room at the Nevada mill. The total length of each circuit is a little more than a mile.

The electric motor room is shown in the illustration, Fig. 3. The six motors are of the regular Brush constant current type, each of 80 h. p. capacity, and are arranged in a single row parallel with the main driving shaft, to which they are all belted in the ordinary manner. The surface water-wheel is also connected to this same shaft. It will be noted that there is here a very novel and interesting feature. This surface wheel uses the water in the first instance and furnishes part of the power to drive the main shaft. The waste water, after this primary use, is carried down the Chollar shaft to the underground chamber, where it drives the dynamos which generate the electric current and energize the electric motors above ground, which in turn furnish additional power to the main shaft.

Each electric motor has its own independent circuit fed from one of the generators. The well-known Brush centrifugal governor, with which each motor is fitted, regulates the speed sensitively, and all or any number of the motors work perfectly in a battery together, or with the water-wheel. In the motor room there is also an ammeter for each electric motor, to show at all times the current flowing in each circuit. The motors run at a speed of 850 revolutions per minute. Some difficulty was anticipated in operating the motors together on one shaft in the manner described, but none was encountered. The motors have not given a moment's trouble or annoyance of any kind from the start.

Some idea of the economic value of this electric power plant to the mine-owners may be derived from a statement of the saving effected by it. The surface wheel alone requires 312 miner's inches of water to develop power sufficient to drive 40 of the 60 stamps with which the mill is equipped. Moreover, this amount of water is seldom available. Two of the electric motors, working in addition to the surface wheel, will perform the same service with but 72 miner's inches of water, thus effecting a saving of about 77 per cent.

The net commercial efficiency of the plant, taking into account all elements of loss, including that in the conducting wires, is about 70 per cent. In other words, 70 per cent. of the power applied to the shafts of the generators in the underground chamber is delivered for work at the main shaft in the mill.

The waste water from the 1,650 foot level of the Chollar mine is piped into the Sutro Tunnel. It is now proposed to use this water a third time at a lower level for other work by means of a similar application of electrical machinery.

It was expected at the outset that many difficulties would be met in an installation of such novel and original character, which was also by far the largest ever attempted. The projectors, the Brush Electric Company, and their agents, the California Electric Light Company, who assumed charge of the details of the erection, were very greatly pleased to find that their forethought had eliminated the troubles anticipated and predicted in almost all respects. Two purely technical difficulties were encountered when the plant was started experimentally, which caused some delay and anxiety. They were, first, the lack of any governing appliance for the water wheels, and second, the damage to the generators caused by the extreme heat and dampness in the underground station. The Brush Electric Company in its original plans and specifications stipulated that the water-wheel should be governed within reasonable limits; but this requirement was not met, and the first generator and motor, started up experimentally, showed the necessity of this provision. The Brush Company was surprised to receive by telegraph the first intimation that the makers of the water-wheels had wholly neglected such an important matter, but was fortunately able to remedy the defect at once. A water-wheel governor, invented by Mr. W. B. Devereux, the prominent mining engineer, of Aspen, Colorado, had been placed in the hands of the company some time previously, and working drawings of it had been made at Cleveland. These were at once sent to California, the governors were quickly made, and this source of trouble was overcome. Mr. F. E. Smith, the electrical engineer in charge of the installation, made several modifications of the governor, after watching its performance, which proved of much value, and it has worked perfectly in practical service.

The second difficulty was met with equal promptness and likewise entirely overcome. The temperature of the subterranean power chamber is about 72 degrees F. The atmosphere is almost saturated with moisture, 78 per cent. Any piece of metal taken into it begins immediately to "sweat." The generators when placed in this chamber were soon covered and saturated with moisture, and began to show leaks, while the motors above ground were absolutely free from any trouble.

The Brush Company was at once notified of this unanticipated source of difficulty, and Mr. Brush speedily devised a method of insulation which would certainly and completely resist the moisture of the atmosphere. Since its application the generators have worked admirably, and the entire plant is now at work regularly, performing its expected duty and economizing the power available, as stated above.

The achievements of the Brush Electric Company in connection with this plant on the Comstock is a very notable one, and of the greatest interest to mining engineers. The plant is by far the largest electrical power plant in the world. The company is making a specialty of powerful generators and motors for power transmission and distribution, and is taking large orders for them, not only in this country, but also for foreign shipment. The latest contract announced is one with the Calumet & Hecla Mining Company for five of the large Brush generators of 130 h. p , and five 80 h. p. Brush motors. A power station will in this case be built above ground for the generators, and the motors will be used for driving pumps underground. The plant goes to the copper mine at Calumet, Mich.

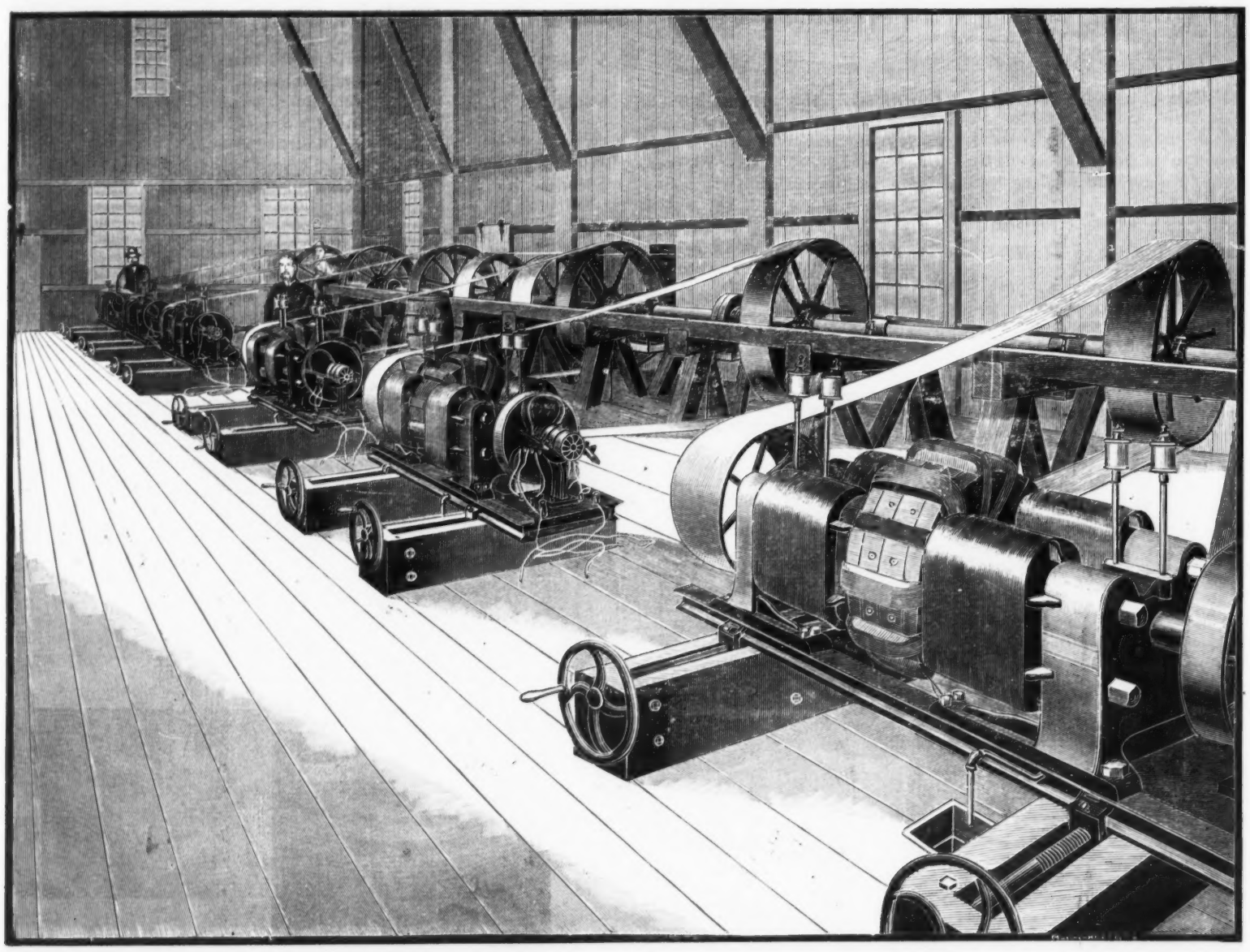


FIG. 3.—ELECTRIC MOTOR ROOM AT THE NEVADA STAMP MILL.

Medical Electrolysis.

Dr. Dujardin-Beaumetz brought before the French Academy of Medicine on the 13th of March a patient cured of constriction of the œsophagus by electrolysis by Dr. Fort. The patient, who came from Nièvre, arrived in Paris on Feb. 16. The œsophagus did not measure more than five millimetres in diameter, and only allowed with difficulty the passage of a few drops of soup. The patient now eats all kinds of food, he has gained 10 pounds in weight, and the œsophagus now measures 14 centimetres in diameter. This is the first instance of the application of electrolysis to the cure of constriction of the œsophagus.

Resistance of Platinum Wire.

To the Editor of The Electrical World:

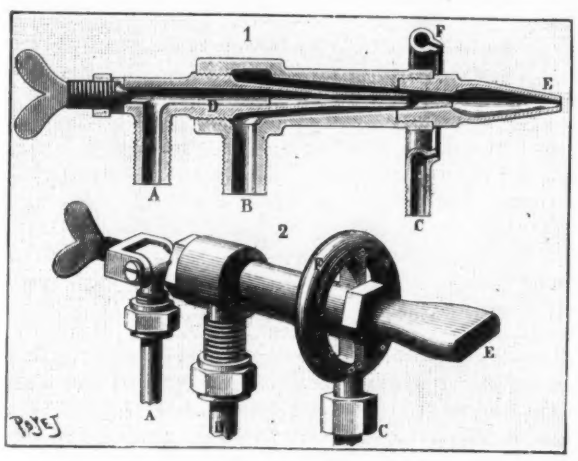
SIR: Can you furnish me with the resistance in ohms of platinum wire, Nos. 30, 32, 34 and 36 respectively, each piece supposed to be one foot in length? By doing so you will greatly oblige me. F. M. T.

FULTON, N. Y.

ANSWER.—The resistances of 1 foot of the sizes of platinum wire given are approximately as follows: No. 30, 0.587 ohm; No. 32, 0.934 ohm; No. 34, 1.487 ohms; No. 36, 2.365 ohms.—EDS. E. W.

A Novel Oil Burner.

In a recent issue we described the arrangement designed by the Racine Hardware Manufacturing Company, of Racine, Wis., for burning crude oil and petroleum in the furnaces or boilers, in which an oil burner of peculiar construction was described. To this description we would add that of another design by Mr. James Holden, intended for use primarily on some locomotives of the Great Eastern Railway of England. This burner is shown in section and perspective in the accompanying illustrations. It is constructed so as to furnish two sheets of flame. The



A NOVEL OIL BURNER.

vaporized petroleum enters by the central tube *B* and is sucked into the burner by a current of steam taken from the boiler, the steam entering by the tube *A* and passing through the central tube *D* of the burner. An annular blower *F*, also fed by steam from the tube *C*, effects the combination with the air necessary to insure perfect combustion. The mixed air and vapor finally pass out by the spout *E*, divided into four passages and are spread out in a single sheet.

On Recalescence in Steel, and its Relation to Expansion, Magnetization and Hardening.

BY ELIHU THOMSON.

The curious property of recalescence of steel observed when this metal is cooling. and the reverse effect of critical temperature during heating, has been examined by Dr. J. Hopkinson, and I have recorded my own observations of this property in a recent note.* This property is found not only to bear a distinct relation to the magnetizability of steel but also gives rise to critical points in the expansibility during heating, and is apparently closely related to the phenomenon of chilling of steel by sudden cooling.

The property of recalescence, pointed out by Professor Barrett,can be readily observed in a simple way by taking a piece of steel wire of, say $\frac{1}{8}$ or $\frac{3}{32}$ in diameter, and heating it, or a section of it at one end, or in any part of the length, to a bright red heat. Now examine closely the cooling in a moderate light or in a dark place. At about a low red a re-heating will be observed which will begin at that part which first reaches the critical point of temperature and will proceed along gradually so as to traverse the part which was heated. The recalescing portion is often seen as a moving band of slightly brighter red on the duller red of the rest of the bar. On heating the bar, also, a close inspection of the increase of temperature, as indicated by the red, luminous surface, shows a moving band rather sharply marked from the cooler portion, and showing a point of absorption of heat or cooling, instead of increase of temperature, as in the former case.

The blow-pipe flame is sufficient for the experiment, but the same effects are obtained by a heating current of electricity sent through the bar. There is then a critical point in the temperature of steel, at which point, when reached during cooling, there is a giving out of heat which raises the temperature of the bar; and, when a similar point is reached on heating, a quick absorption or rendering latent of heat energy takes place, which absorption actually *cools* the bar apparently, not simply checking the heating.

Another remarkable fact is that this critical temperature appears to differ in different steels, being higher in some than in others. I find this to be the case with specimens I have used, my attention having been directed to this fact by Mr. Robert Shand, who assisted in the observations.

My observations of these steels have not gone far enough to determine whether the range of reheating and cooling during heating measured in degrees of temperature, varies for each specimen, but presumably it does. Neither have I been able to determine whether the temperature of critical effect is related to the carbon percentage of the steel, but there appears to be suggested some such relation, and the possibility, perhaps, of noting the carbon from the temperature of recalescence. Pure iron does not exhibit the phenomenon, so far as I have been able to detect. The temperature of recalescence has been shown to be that at which magnetizability is regained, or, at least, at which the property of magnetism is being rapidly restored.

To test the question of its relation to expansion by heat and to discover whether the re-heating during cooling and the critical absorption of heat during heating affected the dimensions of the bar as would extraneous heating or cooling, I constructed an ordinary bar pyrometer having the wire or bar of steel fixed at one end and having attached to the other a lever serving to magnify the movement of the free end three hundred times by moving a pointer on a dial. The wire was gradually heated by the passage of an electric current of practical constancy, and allowed to cool by cutting off the current. Arrangements were also made to test the magnetic power simultaneously.

The results were very striking. During heating and expansion the needle moved steadily up to a certain point, when it stopped, retrogressed on the dial a considerable space, stopped again, and then took up its forward motion of expansion, which progressed steadily again during continued increase of heating by the current. During cooling after removal of the current, the needle or index steadily retrogressed until it had got beyond the critical point of heating, when it suddenly stopped and briskly moved forward through a greater space than before, and stopped again to resume its retrogres sion during continued cooling. Oscillating the temperature around the zone of recalescence by taking off and putting on current at short intervals seemed gradually to lessen the range of reversals of movement which could be produced, but on allowing the temperature to depart considerably from the critical temperature the property was recovered. Iron gave no such results. The resumption of magnetic qualities accorded with the temperature of recalescence or re expansion during loss of heat.

The close relation between the magnetic and thermal effects served to give rise to the suspicion that the hardening and tempering effects might also be related. Experiments were made by heating a bar and plunging it into water to chill it. It was found that if plunged at, or above, the temperature of recalescence the steel would chill and become glass-hard and brittle, and that if plunged into water just after the recalescence had been completed, and the cooling below that point begun, the steel, though hardened somewhat, was also toughened, and could be bent and filed and was very strong.

Here, then, is a means for toughening and partial hardening by plunging the steel into cooling fluid at a temperature just below that of recalescence. May not this latter property serve as an excellent indicator in the working of steel, as it is easily observable by the eye? If the cooling was allowed to go considerably below that of recalescence, and the steel was then quickly cooled, it became very soft. Blacksmiths and others have been in the habit of cooling steel to redness just visible in the dark, and then chilling in the water for rendering the steel soft and easily cut and filed.

It may be mentioned that although no exact measurements were possible the coincidences above pointed out are certainly significant and striking. The total re-expansion during loss of heat is estimated approximately at $\frac{1}{2000}$ of the length of the bar, though the estimate is subject to error.

The phenomena seem to indicate the possibility of a molecular re-arrangement occurring at the critical temperature, in some way connected with the presence of the small amount of carbon of the steel. On heating to this temperature there appears to begin a molecular disturbance requiring energy, which energy is abstracted from the store of heat in the bar, even lowering the temperature. This disappearance of heat requires, consequently, a higher temperature to initiate the change than exists during and after the change itself. In like manner, on cooling a heated bar, a lowering of temperature to begin the recalescence is required below that which permits its continuance when begun, and the energy before absorbed is now returned.

The specific heat of steel is critical at two points, therefore, viz., the temperature at which begins the evolution of sensible heat, called recalescence, and the temperature at which, during heating, the absorption of the sensible heat, or decalescence, if I may so term it, begins.

A few other wires of metals and alloys tried gave no results, and the property seems to be peculiar to steel, though it would require an extended examination to settle this point. Another interesting question would be, at what percentage of carbon in iron the property makes its appearance and what is the effect of continued increase of the carbon? It would also be of interest to determine the effects which allied metals, such as nickel, cobalt, manganese and admixtures of these with steel, as well as steels with other admixtures, such as tungsten, silicon, etc. which have marked influence on the general character of the metal, would produce.

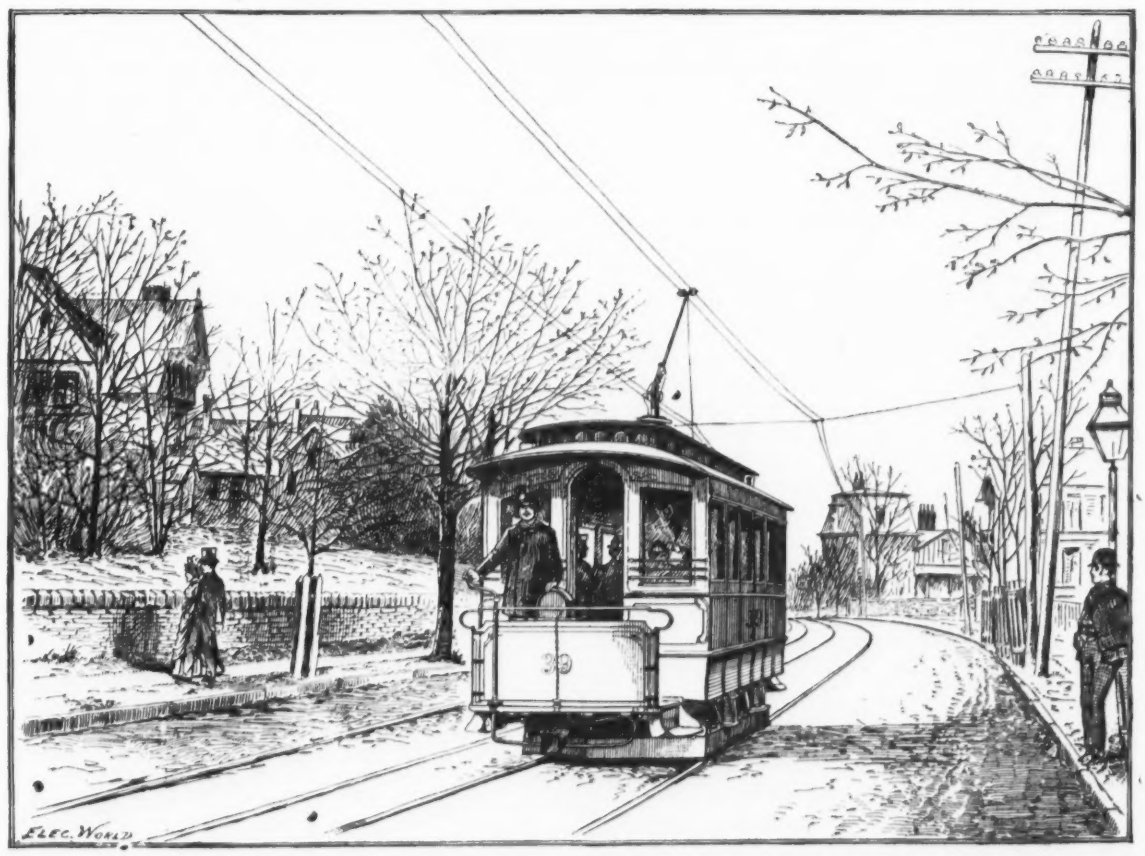
Whether cast iron exhibits the property in question is not known to me, pressing work of other character preventing a continuance of these experiments for the present at least.

* See THE ELECTRICAL WORLD, April 27, 1889.

The Daft "Double Trolley" Road at Cincinnati, O.

The Daft road at Cincinnati, known as the Walnut Hills Electric Line, was formally opened April 20, 1889. It has been continuously and successfully operating since. It is the only road now running using a double trolley with underneath contact. The trolleys are of a new design and the mast arms are very strong and simple in construction as well as ornamental. No attention is given to the trollies by either the drivers or the conductors, and at high speeds, curves and other difficult places, no trouble is encountered with them.

The principal advantage possessed by the double system is that no earth return is used, and no induction is experienced in parallel circuits, either telephone or telegraph;



THE DAFT DOUBLE TROLLEY ROAD AT CINCINNATI, O.

and crossed wires with grounded terminal instruments are not burned.

A potential of 220 volts is used, which reduces sparking at the brushes of the motors and the trolley contacts, and which is absolutely safe.

The road is in a narrow and crowded street, in one mile having six crossings, eight curves and a seven and a half per cent. grade to encounter; but the service is rapid and efficient, and the operation of the road is commercially successful.

Part of the route is over the cable tracks on Gilbert avenue, and the electric cars have had several times to tow in cable trains when the latter have broken down. On one occasion recently an electric car, while towing a heavy train of disabled cable cars, tore off its rear platform. This is mentioned only to show the tractive power developed.

The cars are equipped in very handsome style and are largely patronized. The judgment of Mr. Geo. B. Ker-

per, the president of the road, who was first to take up the application of electricity to the propulsion of street cars in Cincinnati, has been more than justified by the successful commercial operation of this line of road.

The Topeka, Kan., Rapid Transit Electric Railway.

While it is a fact that the West End Railway Company, of Boston (combining its two systems), operates more miles of electric railway than any other company in the world, the electric railway at Topeka is still the longest line which has yet been built, using one system, and receiving its current from one central station. The roads which have heretofore been built by the Thomson-Houston Company in the West have been constructed in the best possible manner, and are successful in every particular, but the road in question is by far the longest, and no pains have been spared to make it a model in every respect. Its operation since its starting on the first of April has proved this. The construction work was begun about Jan. 1 and finished about the beginning of April. When it is called to mind that this road is 14 miles in length, and has a total length of track of 20 miles, and that the utmost care was exercised in its construction, even to the smallest details, it will be seen that good time was made. The trial trip was announced for April 3, and was most successful in every way. It was quite a gala day for Topeka, the public, generally, turning out to witness what was to them a most novel sight.

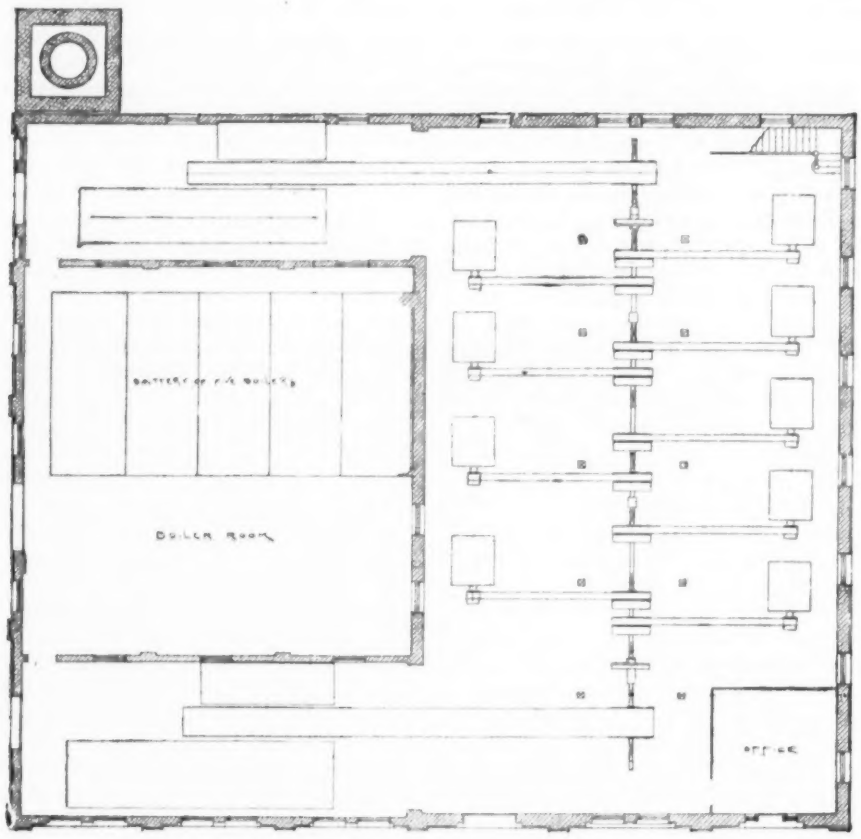
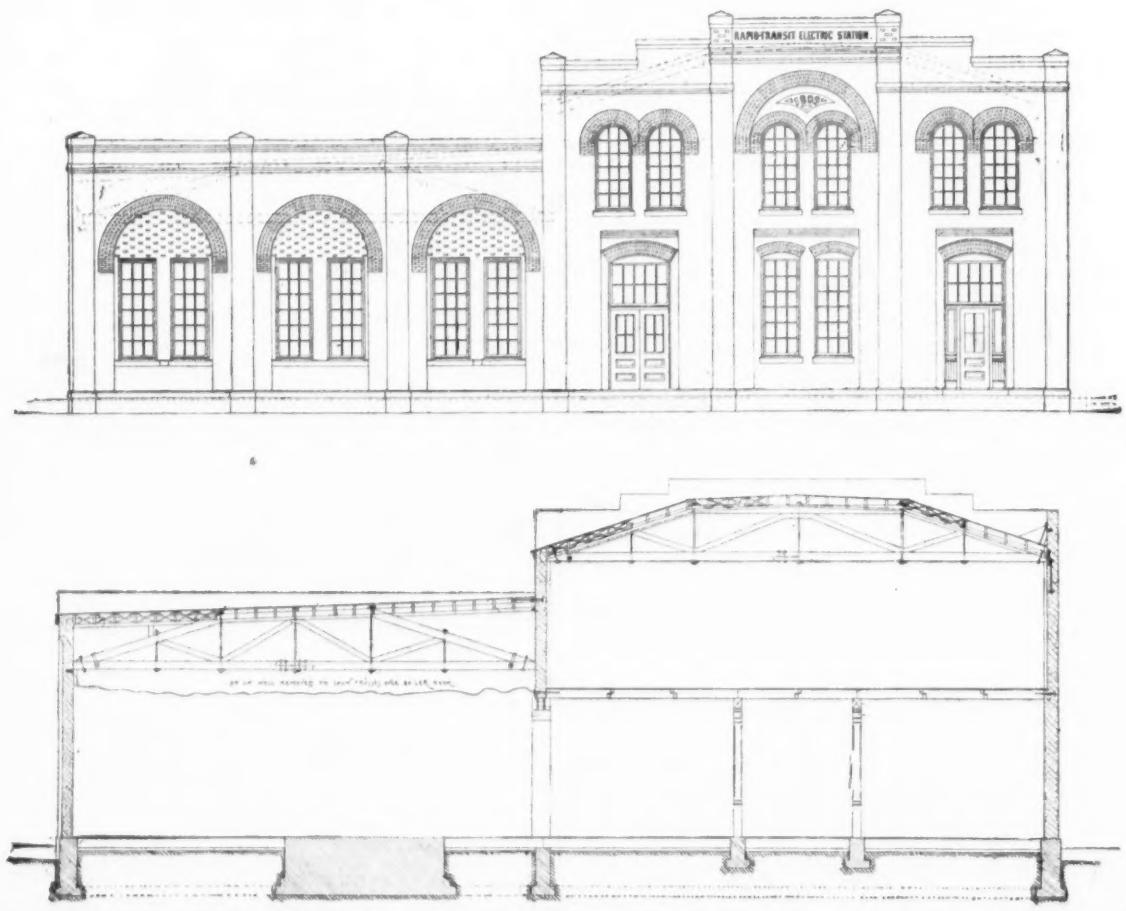


FIG. 3.—PLAN OF DYNAMO ROOM, POWER STATION, TOPEKA, KAN.

The power station, a very handsome brick building, is illustrated by the accompanying cuts, Figs. 1, 2 and 3. It is located at the corner of Second and Jefferson streets. It has a front of 100 feet and a depth of 85 feet. One-half of the building is two stories high. At the rear of it is a massive chimney 125 feet high. The foundations of the dynamos and engines are of solid masonry resting on bed rock, thus securing the utmost stability and firmness. The engines are two in number, and are of the Corliss type, built by E. P. Allis & Co., of Milwaukee, subject to a special order by L. H. McIntire, the mechanical engineer who has designed and superintended the construction of the entire plant. The smaller engine is capable of developing 300 h. p., and has a fly-wheel 20 feet in diameter, weighing 26,000 pounds. The larger engine is of 600 h. p., and has a 20 foot fly-wheel weighing 20 tons. The smaller engine, as will be seen on reference to the cut, is situated at one end of the building, the larger one directly opposite, and both are belted to the main shaft which runs the entire length of the building. Each engine rests on a foundation consisting of a concrete base, upon which are placed large blocks of stone laid in cement to a thickness of about 10 feet. The foundations are entirely independent, so that when the engines are running there is no appreciable jar communicated to the building. The engines are run at 80 revolutions per minute.

The battery of five boilers which supplies the steam for these engines is located between them in a brick inclosure, which entirely isolates it from the dynamo and engine rooms. These boilers are built of the best quality of steel, are six feet in diameter and are each 16 feet long. They are arranged so they can be run separately or in series. The feed water for these boilers is taken from driven wells 65 feet deep. The water is first pumped into an exhaust heater, and the temperature is raised to 212 degrees Fahrenheit. A peculiarity in this exhaust heater is that the water enters at the top and is received by a crescent-shaped pan. From this pan the water runs over the edges, following the bottom until it reaches the centre of the pan, when it drops into a similarly shaped pan, and so on into another pan, until it passes into 16 different pans By this arrangement the exhaust steam strikes the water as it drops from pan to pan 16 different times, and removes all the impurities that can be taken out with the above-mentioned temperature. This water is then delivered by a special pump, fitted for handling hot water, into a superheater which is placed above the boilers. This heater is 26 feet long and contains 24 pans like those used in the exhaust heater. Live steam from the boiler is kept at full pressure upon this superheater, which carries the temperature up to 320 degrees. The high temperature to which the feed water is subjected causes the lime, iron, magnesia and other impurities to collect on the bottom of these pans. The floor of the boiler room is paved with hard brick. A track for a coal car runs in front of the furnace doors, enabling the fireman to transport coal from without the building to the furnace.



FIGS. 1 AND 2.—THE POWER STATION, THOMSON-HOUSTON ELECTRIC ROAD, TOPEKA, KAN.

The electrical apparatus consists of five 80 h. p. Thomson Houston generators for supplying the necessary current. These generators are compound wound and connected in multiple. There is also used a large switch board fitted with the necessary current indicators, switches, etc. In building the line the overhead method of construction has been employed, the rails serving for the return circuit. The cars, twelve in number, are each equipped with two 10 h. p. motors.

Since the road has been in operation it has been visited by many prominent railway men, and it has been the generally expressed opinion that the road in construction and operation is a model electric railway, and reflects the utmost credit upon the Thomson-Houston Electric Company, its constructors and their engineering force.

The Perry Method of Measuring High Potentials.

BY F. L. PERRY.

In THE ELECTRICAL WORLD of April 6, 1889, I published a description of a simple method of measuring high potentials with a low reading voltmeter and a series of incandescent lamps. This same method was recently referred to by the *Elektrotechnischer Anzeiger*, a German paper published in Berlin. The *Elektrotechnischer Anzeiger* suggests that a similar arrangement might be adapted to arc dynamos to serve as an optical signal.

The idea advanced was to connect in a series and arrange in shunt to the circuit at the dynamo such a number of incandescent lamps that the E. M. F. of the machine would be sufficient to bring them all to candle power. These lamps were to be distributed throughout the dynamo room, to light it, and at the same time serve as "pilot lamps,"—that is, any disturbance on the circuit or failure in the dynamos would be indicated by the manner in which the incandescent lamps burned.

This application of the method is doubtless a good one, and, where a single dynamo is in question, seems perfectly feasible; but in a station where a large number of machines are in service the scheme is hardly as practicable as that embodied in a more complete device designed and constructed some months ago by Gerald E. Fish, Electrician of the Chicago Arc-Light and Power Company.

Mr. Fish's device consists simply of a switch board carrying the terminals of wires leading to the binding posts of the different dynamos and a row or series of incandescent lamps conveniently placed along the top edge of the switch board.

The lamps are so fixed that any number of the series may be quickly thrown in shunt to any dynamo or circuit connecting with the board.

By this arrangement and using a voltmeter, as was previously described in the issue of April 6 (*i. e.*, measuring along the series as many lamps at one time as the instrument will take, and adding together these several measurements for the total E. M. F.), it is but the work of a moment to test any dynamo of quite a large number in the station.

A Correction in Bottone's Dynamo Building.

To the Editor of The Electrical World:

SIR: In Bottone's "The Dynamo: How Made and How Used," page 67, line 5, should not the 6th word read "commutator" instead of "armature?" Also the same change in the last word of the sentence?

PRINCETON, N. J. WM. ELMER, JR.

ANSWER.—Our correspondent is correct. The words should read as stated by him.—EDS. E. W.

The Ganz Alternating Machine and Transformer.

In the recent paper on "Central Station Lighting in Europe," which Professor Forbes read before the London Institution of Electrical Engineers, attention was directed to the work done by Messrs. Ganz & Co. in Rome, Milan and elsewhere, and an illustrated description of the types of machine and transformer employed will, therefore, be of interest to our readers. In its early form the Ganz alternator had a star-shaped field magnet of non-laminated iron revolving within a cylindrical armature, the core of which was composed of thin ring-shaped iron plates held in a frame. The armature coils were flat bobbins laid upon the inner surface of the armature core side-by-side, with insulated filling-in pieces interposed. The magnetic resistance of the interpolar spaces was in this arrangement necessarily high, and in the later machines this difficulty has been overcome by employing an armature core with a series of internal Pacinotti projections. These projections form the cores of the armature bobbins, and to avoid the heating of the pole pieces, the field magnets are now built up of U-shaped iron plates *F*, as shown in Fig. 2. These plates are laid upon each other, and arranged round the spindle so as to form a star, alternate layers being arranged to break joint, as shown by the dotted lines in the illustration. The plates are fastened together by insulated bolts *B*, and the existing coils are wound upon separate formers, slipped over the magnet cores, and held in position by bobbin holders and screws strong enough to resist the action of centrifugal force. The armature core, which formerly was continuous, is in the new machines sub-divided into a number of T-shaped sections, the central stem of the T forming the Pacinotti projection, *A*, being very short, and of equal width and length with the magnet. These sections are so arranged that each with its armature bobbin can be removed without disturbing the rest of the machine.

The illustration also shows the construction of the armature sections, and the manner of supporting them. The frame of the machine consists of two ring-shaped castings held together by strong bolts, and, in addition, there are iron traversers to which the segments are bolted. In the figure, the section at I is taken close to one of the cast iron rings, showing the internal flange to which the traversers are bolted. The section at II is taken at some intermediate point, showing the traversers and the plates of the armature core, and the section at III is taken at another intermediate point, showing the method by which the armature core is bolted to the traversers. The armature plates are held together by ribbed bronze plates, which also serve to hold the armature coil in its place. In larger armatures bronze plates are also inserted at intermediate points, and they serve for the attachment of the armature section to the traversers by means of insulated bolts and nuts, as shown at III.

Fig. 1 shows a complete machine intended for an output of 80 kilo-watts. In this machine there are fourteen poles and fourteen armature sections, which can be coupled to give a pressure of either 2,000 or4,000 volts with a current of respectively 20 or 40 ampères. The speed of the machine is 360 revolutions per minute, giving 5,040 reversals, or a frequency of 42. The total weight of the iron core, both in field magnets and armatures, is 1 ton 7 cwt., and the total weight of copper is 930 pounds. The resistance of the armature is 1.038 ohms for a 2,000-volt machine, giving a loss of 2.08 per cent. by ohmic resistance in the armature circuit. The resistance of the field magnet circuit is 3.24 ohms, and a current of 28 7 ampères is required at full output, entailing a loss of 3.33 per cent. for excitation.

Some experiments were made with this machine to ascertain the various losses. When driven in a non-excited

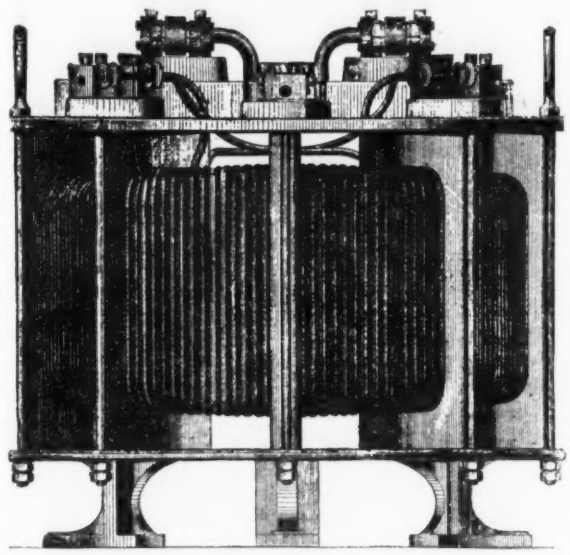
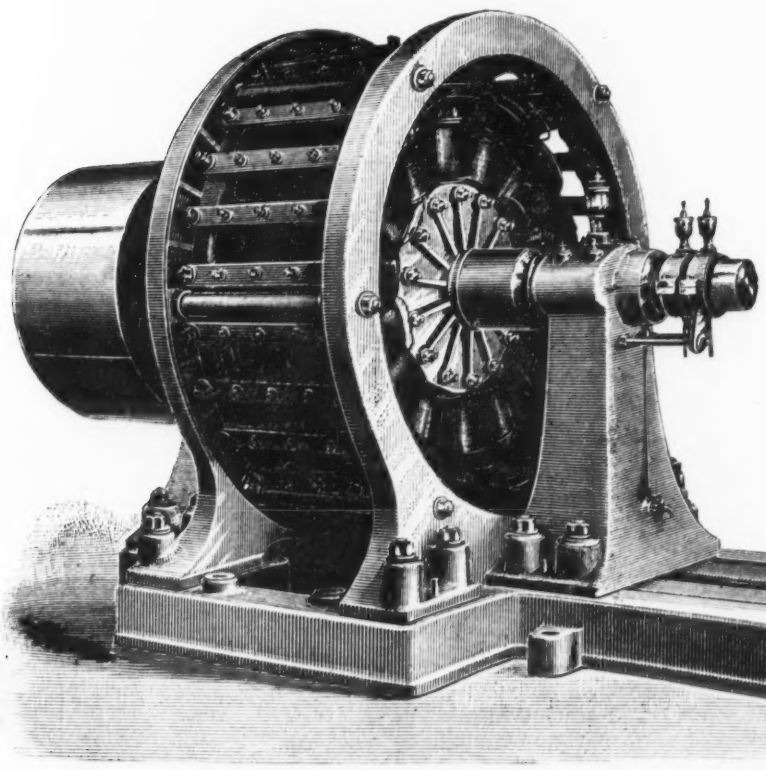


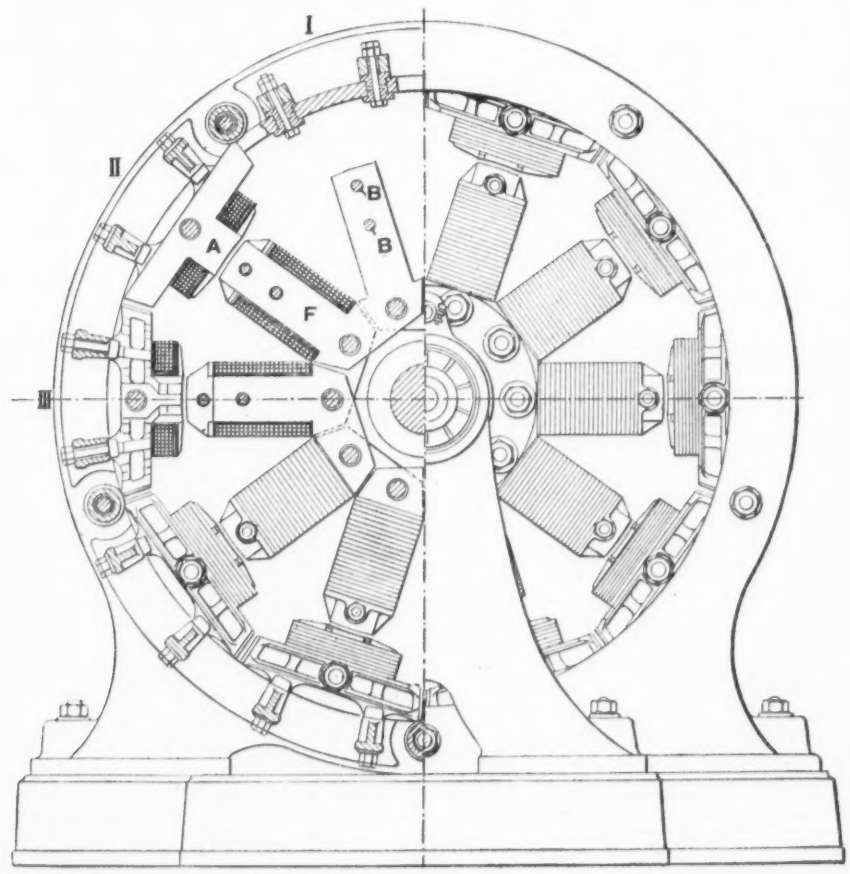
FIG. 3.—GANZ TRANSFORMER.

field by a belt at the normal speed, 4.07 h. p. was consumed in journal friction and windage. The field magnets were then excited so as to produce a terminal pressure of 2,000 volts, but no current was allowed to flow through the armature. Under these conditions the power absorbed was 9.81 h. p., showing that hysteresis and Foucault currents absorbed 5.74 h. p. We are informed by the makers, says *Industries*, that the total commercial efficiency, including the power required to excite the machine, is at full output 87 per cent.; and this figure is somewhat increased when the machine is direct driven by a steam engine.

In order to facilitate the cleaning of the armature coils, Messrs. Ganz & Co. have from the very first arranged the frame of the armature in such a way that it could be shifted longitudinally beyond the space occupied by the field magnets, so as to expose the whole of the internal surface, and make it easily accessible, both for cleaning and for the renewal of a coil should it have been damaged. In the new type of machine, the armature itself is, however, kept fixed, and the magnet wheel is arranged to slide longitudinally, for which purpose one of the standards is fitted similarly to the slide rest of a lathe. In order to slide back the magnets, the pulley must be removed, and the standard on the opposite side can then be drawn back by means of a ratchet bar, screw, and nut to its outermost position.

The illustration, Fig. 3, represents the type of transformer now adopted by Messrs. Ganz & Co. The core of the transformer consists of ring-shaped discs of iron laid upon, but insulated from, each other, and firmly held together by clamps of well varnished wood, which divide the cylindrical core into several sections. Each section contains a primary and secondary coil, the primary being next to the core. To the ends of the clamps are attached two stout circular iron discs of larger diameter than the transformer itself when wound, so that the whole apparatus may be rolled about the floor on these iron discs without danger of injuring the winding. The terminals are attached to a porcelain disc fitted on one of the iron discs, while the other is provided with foot brackets, as shown.





FIGS. 1 AND 2. GANZ & COMPANY'S ALTERNATING CURRENT MACHINE.

Mr. Nikola Tesla on Alternating Current Motors.

To the Editor of The Electrical World:

SIR: About a year ago I had the pleasure of bringing before the American Institute of Electrical Engineers the results of some of my work on alternate current motors. They were received with the interest which novel ideas never fail to excite in scientific circles, and elicited considerable comment. With truly American generosity, for which, on my part, I am ever thankful, a great deal of praise through the columns of your esteemed paper and other journals has been bestowed upon the originator of the idea, in itself insignificant. At that time it was impossible for me to bring before the Institute other results in the same line of thought. Moreover, I did not think it probable—considering the novelty of the idea—that anybody else would be likely to pursue work in the same direction. By one of the most curious coincidences, however, Professor Ferraris not only came independently to the same theoretical results, but in a manner identical almost to the smallest detail. Far from being disappointed at being prevented from calling the discovery of the principle exclusively my own, I have been excessively pleased to see my views, which I had formed and carried out long before, confirmed by this eminent man, to whom I consider myself happy to be related in spirit, and toward whom, ever since the knowledge of the facts has reached me, I have entertained feelings of the most sincere sympathy and esteem. In his able essay Prof. Ferraris omitted to mention various other ways of accomplishing similar results, some of which have later been indicated by O. B. Shallenberger, who some time before the publication of the results obtained by Prof. Ferraris and myself had utilized the principle in the construction of his now well known alternate current meter, and at a still later period by Prof. Elihu Thomson and Mr. M. J. Wightman.

Since the original publications, for obvious reasons, little has been made known in regard to the further progress of the invention; nevertheless the work of perfecting has been carried on indefatigably with all the intelligent help and means which a corporation almost unlimited in its resources could command, and marked progress has been made in every direction. It is therefore not surprising that many, unaquainted with this fact, in expressing their views as to the results obtained, have grossly erred.

In your issue of May 4 I find a communication from the electricians of Ganz & Co., of Budapesth, relating to certain results observed in recent experiments with a novel form of alternate current motor. I would have nothing to say in regard to this communication unless it were to sincerely congratulate these gentlemen on any good results which they may have obtained, but for an article, seemingly inspired by them, which appeared in the Lon-

don *Electrical Review* of April 26, wherein certain erroneous views are indorsed and some radically false assertions made, which, though they may be quite unintentional, are such as to create prejudice and affect material interests.

As to the results presented, they not only do not show anything extraordinary, but are, in fact, considerably below some figures obtained with my motors a long time ago. The main stress being laid upon the proposition between the apparent and real energy supplied, or perhaps more directly, upon the ratio of the energy apparently supplied to, and the real energy developed by, the motor, I will here submit, with your permission, to your readers, the results respectively arrived at by these gentlemen and myself.

Energy apparently supplied in watts.		Work performed in watts.		Ratio of the energy apparently supplied to the real energy developed.	
Ganz & Co.	Westinghouse Co.	Ganz & Co.	Westinghouse Co.	Ganz & Co.	Westinghouse Co.
18,000	21,840	11,000	17,595	0 611	0.805
24,200	30,295	14,600	25,365	0 603	0.836
29,800	43,624	22,700	36,915	0.761	0.846
....	56,800	....	48,675	....	0.856
....	67,500	....	59,440	....	0.88
....	79,100	....	67,365	....	0.851

If we compare these figures we will find that the most favorable ratio in Ganz & Co.'s motor is 0.761, whereas in the Westinghouse, for about the same load, it is 0.836, while in other instances, as may be seen, it is still more favorable. Notwithstanding this, the conditions of the test were not such as to warrant the best possible results.

The factors upon which the apparent energy is mainly dependent could have been better determined by a proper construction of the motor and observance of certain conditions. In fact, with such a motor a current regulation may be obtained which, for all practical purposes, is as good as that of the direct current motors, and the only disadvantage, if it be one, is that when the motor is running without load the apparent energy cannot be reduced quite as low as might be desirable. For instance, in the case of this motor the smallest amount of apparent energy was about 3,000 watts, which is certainly not very much for a machine capable of developing 90 h. p. of work; besides, the amount could have been reduced very likely to 2,000 watts or less.

On the other hand, these motors possess the beautiful feature of maintaining an absolutely constant speed no matter how the load may vary. This feature may be illustrated best by the following experiment performed with this motor. The motor was run empty, and a load of about 100 h. p., far exeeeding the normal load, was thrown on suddenly. Both armatures of the motor and generator were seen to stop for an instant, the belts slipping over the pulleys, whereupon both came up to the normal speed with the full load, not having been thrown out of synchronism. The experiment could be repeated any number of times. In some cases, the driving power being sufficient, I have been enabled to throw on a load exceeding 8 to 9 times that which the motor was designed to carry, without affecting the speed in the least.

This will be easily understood from the manner in which the current regulation is effected. Assuming the motor to be running without any load, the poles of the armature and field have a certain relative position which is that of the highest self-induction or counter electromotive force. If load be thrown on, the poles are made to recede; the self-induction or counter electromotive force is thereby diminished and more current passed through the stationary or movable armature-coils. This regulation is very different from that of a direct current motor. In the latter the current is varied by the motor losing a certain number of revolutions in proportion to the load, and the regulation would be impossible if the speed would be maintained constant; here the whole regulation is practically effected during a fraction of one revolution only. From this it is also apparent that it is a practical impossibility to throw such a motor out of synchronism, as the whole work must be done in an instant, it being evident that if the load is not sufficient to make a motor lose a fraction of the first revolution it will not be able to do so in the succeeding revolutions. As to the efficiency of these motors, it is perfectly practicable to obtain 94 to 95 per cent.

The results above given were obtained on a three-wire system. The same motor has been started and operated on two wires in a variety of ways, and although it was not capable of performing quite as much work as on three wires, up to about 60 h. p. it gave results practically the same as those above-mentioned. In fairness to the electricians of Ganz & Co., I must state here that the speed of this motor was higher than that used in their experiments, it being about 1,500. I cannot make due allowance for this difference, as the diameter of the armature and other particulars of the Ganz & Co. motor were not given.

The motor tested had a weight of about 5,000 lbs. From this it will be seen that the performance even on two wires was quite equal to that of the best direct current motors. The motor being of a synchronous type, it might be implied that it was not capable of starting. On the contrary, however, it had a considerable torque on the start and was capable of starting under fair load.

In the article above referred to the assertion is made that the weight of such alternate current motor, for a given capacity, is "several times" larger than that of a direct current motor. In answer to this I will state here that we have motors which with a weight of about 850 pounds develop 10 h. p. with an efficiency of very nearly 90 per cent., and the spectacle of a direct current motor weighing, say 200–300 pounds and performing the same work, would be very gratifying for me to behold. The motor which I have just mentioned had no commutator or brushes of any kind nor did it require any direct current.

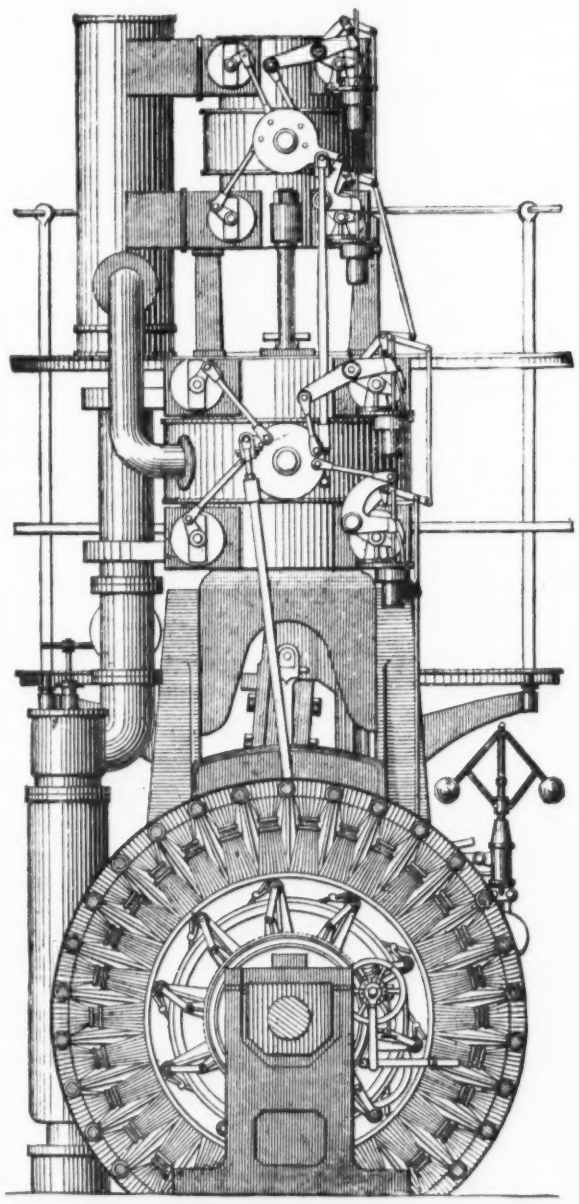
Finally, in order to refute various assertions made at random, principally in the foreign papers, I will take the liberty of calling to the attention of the critics the fact that since the discovery of the principle several types of motors have been perfected and of entirely different characteristics, each suited for a special kind of work, so that while one may be preferable on account of its ideal simplicity, another might be more efficient. It is evidently impossible to unite all imaginable advantages in one form, and it is equally unfair and unreasonable to judge all different forms according to a common standard. Which form of the existing motors is best, time will show; but even in the present state of the art we are enabled to satisfy any possible demand in practice.

NIKOLA TESLA.

PITTSBURGH, Pa.

The Berlin Electric Light Stations.

In the paper recently read before the London Institution of Electrical Engineers, an abstract of which we published



ENGINE AND DYNAMO COMBINATION, BERLIN STATION.

in a recent issue, Prof. George Forbes described the Berlin, Germany, central stations, as follows:

The Berlin mains are at present, I believe, supplying a larger number of lights than any other connected system of mains in Europe. They supply 36,000 lamps of 16 candle-power and 144 arc lamps of 15 ampères. The conductors are all laid underground. A map is shown giving the position of mains already laid down and those in progress of construction. There are three central stations at work, and two more of improved type are in process of construction. The existing stations are:

1. Markgrafen Strasse.
2. Mauer Strasse.
3. Friedrich Strasse.

Those about to be added are—

4. Spandauer Strasse.
5. Schiffbauer Damm.

The first is the most important; the third is quite unimportant. Here the boilers are by Steinmiller, and anthracite coal is used to prevent nuisance from smoke. The foundations are of concrete in iron boxes built up with brickwork and cement. There are six engines of 160 h. p. each, each driving old-fashioned Edison six-legged dynamos. There are also four engines of 400 h. p. each, each driving a new type of dynamo direct at 80 revolutions per minute. These are compound tandem Corliss condensing engines by Van den Kirchove, of Ghent. The attached dynamos are by Siemens & Halske. The Electric Company of Berlin are also making a machine somewhat similar. The illustration Fig. 1 shows this dynamo and engine combined, the height of which is 23 feet. These continuous-current dynamos are worthy of some notice. They may be described as multipolar Gramme machines, the poles being radial and the ring armature external to the poles.

There are ten poles on each machine. The armature is 3 metres in diameter, the commutator is 1½ metres in diameter. There are ten brush-holders. Each pair of poles and the corresponding part of the armature, with the corresponding pair of brush holders, constitute a section which is virtually one machine. All these sections are joined in parallel. The field magnets are not seen in the drawing, being inside the armature. Two handles are provided, one of which adjusts all the brushes at the same time; the other puts them on all together. Each brush-holder carries four brushes. A similar dynamo is being made by the Berliner Elektricitäts-Werke, in which the radial poles are external to the armature. I believe that this type of multipolar machine is a good design where the object is to get a large output with a slow speed. I hold working drawings in my hand of a similar design prepared by myself in 1881, but it was never executed. The number of bars of the commutator and the number of parts generally make it expensive to construct.

At this station the boilers are fed automatically by means of a hydraulic accumulator. The water for condensing is drawn from 15 artesian wells which have been sunk for this purpose. Steam is used at a pressure of 115 pounds, and it is claimed that 15.5 pounds of steam only are required per electrical horse-power. This is probably the most economical production of electricity for central station work in the world, and the engines and dynamos, though expensive, must certainly have a very low depreciation. The maximum work which this station can do is to generate a current for 26,000 lamps of 16 candle-power. It is found that the maximum number of lamps in use at any one time is about 66 per cent of the total number of lamps.

The thing which strikes one most in this station is the enormous mass of copper. The conductors inside this station consist of eight strips of copper six inches wide and one-third of an inch thick. These are laid into the room for cable terminals. These strips, before entering this room, are interrupted by a gap, and a junction is made by punching seven similar strips, about 18 inches long, between the strips and the interrupted ends, the seven strips being placed between. Thus, in case of any serious accident, the whole of the mains can by one turn of the screw be disconnected from the dynamos, the interlapping pieces all dropping out. The only exception is in the case of theatres, where, to prevent panic, a separate connection is made with the dynamos. In the cable terminal room the positive and negative mains run horizontally and vertical rods come down to the different cables. There are eighty-four of these cables, forming forty-two pairs of feeders supplying the network of mains with current on the two-wire system. These cables are generally of large size, being frequently three inches in diameter complete. They consist of stranded cables covered with jute prepared with bituminous compound, inclosed in lead, then covered with tape and preservative compound, and finally armor-plated with two crossed spirals of iron ribbon.

On Quartz as an Insulator.*

The author stated that when making quartz fibres by the process described by him some time ago of shooting an arrow, carrying with it a kind of tail of softened quartz, he had observed that, when the fibres were very fine, if they broke off between the bow and the target the extremities assumed the form of a screw about half an inch in diameter and some 8 or 10 inches long. If any body were brought near this screw the end of it would shoot out towards the surface of the body, retracting again when the body was removed. It hardly appeared possible that this could be due to any other cause than to the fibre becoming in some manner electrified during its formation. If, however, this were the case, it would show that quartz must be an exceptionally good insulator under ordinary atmospheric conditions, for otherwise the extremely minute charge which could be carried on so fine a fibre would be dissipated almost as soon as it was generated. It was, of course, quite impossible to obtain any direct proof of the existence of so small a charge beyond that given by the behavior of the screw when any substance was brought near to it. He therefore determined to test the insulating power of quartz under ordinary atmospheric conditions, and he found that quartz is under any circumstances a better insulator than

* Abstract of a paper read before the London Physical Society by Mr. C. V. Boys.

glass, and that under the ordinary atmospheric conditions there was no comparison between them. This was very well shown in an experiment which Mr. Boys exhibited to the Society. A pair of gold leaved had been suspended by means of a hook formed out of a thick quartz fibre, inside a case with glass ends, and had been electrified about five hours before the time of meeting. In order to make the conditions as unfavorable as possible, the air within the case was kept moist by placing a glass dish full of water inside it, and the quartz hook was made very short. When the experiment was exhibited the deflection of the gold leaves had only diminished by about one-fourth of its original amount. If glass had been used as a support for the leaves the electrification would have been entirely dissipated in considerably less than a minute.

The Noyes Novel Box Bell.

The accompanying illustrations represent in elevation and section the new box-bell invented by Mr. J. G. Noyes, of the New Haven Clock Company. As will be seen, the bell has a metallic frame or yoke *D*, that extends along three sides of the frame *B*, and parallel thereto within the frame. The leg *d* of the yoke has a screw-threaded aperture *e*, that receives the threaded end of a standard *E*, on the upper end of which is secured the bell *F*. The standard extends parallel with the upper part of the back *A* as shown, and can only be screwed into the yoke before the back is joined to the open box-frame *B*, on account of the horizontal upper end of the standard, which would otherwise come in contact with the back. The yoke *D* is held in the frame by a screw that passes though one side of the frame and the yoke *D*.

The distinguishing feature of the bell consists in the fact that it has but a single magnet and core. The whole is very neatly designed, and by its construction is not liable to derangement.

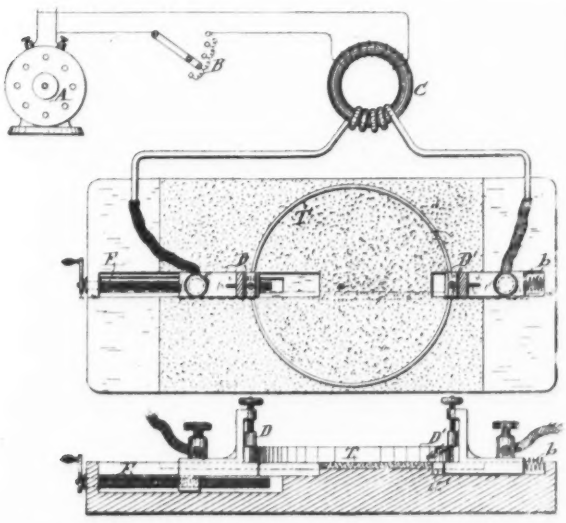
Determination of Sizes for Inside Wiring on the Two-Wire System for Beginners.

BY C. E. GIFFORD.

Map out the wiring to be done; call the wire between each two points where current is fed into or taken from them a "section." Take twice the length of each section in feet, and multiply by the total number of ampères that must flow through it to reach all the lamps which are at the end of that section or on other sections beyond. Call this product for convenience, the "ampère length product" of the section.

If but one gauge of wire is to be used, and it is desired to wire so as to give a certain definite drop of potential between the point where the current enters the building and the most distant lamp, proceed as follows:

Add together the "ampère-length products" of all the sections that are so located that current supplied to the most distant lamp must pass through them on its way from the outside wires. Divide this sum by the number of



FIGS. 1 AND 2.—EXPANDING TIRES BY ELECTRICITY.

ampères required by this lamp, and let *A* stand for the quotient thus obtained.

Find the resistance (hot) of the lamp by dividing the number of volts by the number of ampères, as found on the manufacturers' label. (Volts are often expressed in *whole numbers*, and ampères as *hundredths, with the decimal point omitted*, on the same label. For instance, what is often written "50 volts, 115 ampères," should be written "50 volts, 1.15 ampères.")

Multiply the resistance thus found by the percentage, designating the "drop" to be allowed at this lamp, and let *B* stand for the product.

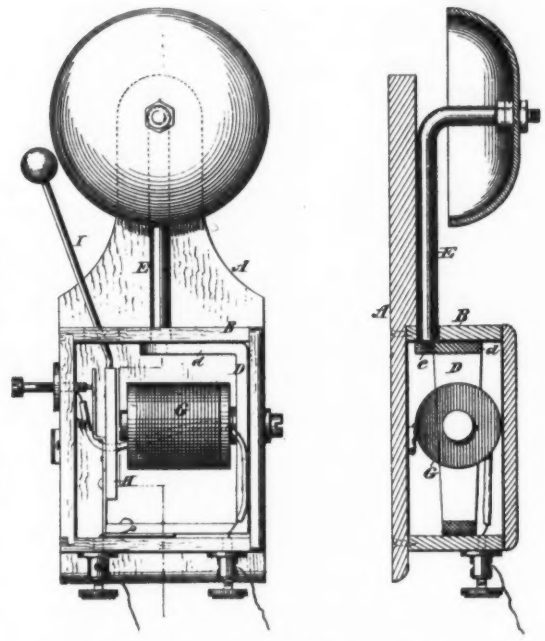
Multiply the total resistance of each "cut-out" (*i. e.*, the added resistance of *both sides*, if double) through which the current must flow in reaching this lamp by the number of ampères flowing through it; add together the products thus obtained for the several "cut-outs," and divide the sum by the number of ampères required by the lamp, and let *C* stand for this quotient.

Let *D* represent the resistance of the cord used with the lamp.

Then, for the required wire we will have:

$$\text{Res. per 1,000 ft.} = 1{,}000 \times \frac{B-(C \times D)}{A} \text{ ohms.}$$

An ordinary table of resistances will show what gauge of wire has a resistance nearest to the result thus obtained. If it is desired to produce the same drop as at the most distant lamp in any other lamp, by means of a smaller cord obtain the value *A'* in the same way that the value of *A* was computed (with reference, however, to the lamp



FIGS. 1 AND 2.—THE NOYES BELL.

now in question). Compute also the values of *B'* and *C'* (corresponding to *B* and *C* in the preceding equation). Let *M* stand for the resistance per 1,000 feet of the wire already fixed upon with reference to the most distant lamp. Then, to produce the desired "drop," we would have:

$$\text{Res. of cord} = B' - \left(M \frac{A'}{1{,}000} + C\right).$$

When desirable to use more than one size of wire in the same local system, use the first formula for determining the size to give any desired portion of the total "drop" at a given point; then make this point a new start for a repetition of the calculation, not repeating, of course, such portions as relate to things already determined.

If we wish to wire so as to obtain a specified *average* "drop," we can, by omitting *branch* cut-outs from the calculation, obtain a close approximation as follows:

Find the average current in the lamps by dividing the sum of the ampères by the number of lamps. Call the quotient *D*. Multiply the total resistance (both sides of cut-out) at main cut-out by the *number of lamps* supplied through it. Call the product *E*.

Divide the current in ampères flowing through each section by the average current. The quotient will give the number of *average lamps* to which current flows over that section. (This number may, of course, be fractional.) Multiply twice the length of each section by the square of the number indicating the number of average lamps to which current is supplied over that section. Add these several products and divide the sum by the total number of lamps. Call this result *F*. Multiply the average lamp resistance (hot) by the percentage indicating the desired average drop, and represent the product by *G*.

Find the average resistance of the cords and ceiling cut outs (cut-out and cord together) and designate by *H*. Then in the wire required we will have:

$$\text{Res. per 1,000 feet} = 1{,}000 \times \frac{G-(E+H)}{F} \text{ ohms.}$$

These formulæ may evidently also be employed for determination of "drop" in existing installations.

Expanding Hoops and Tires by Electric Heating.

The method of expanding hoops and tires which has been practised from time immemorial is too well known to need any description; but the method has always been open to the objection that it did not heat the tire uniformly. In more modern practice, gas furnaces have been used for the purpose, but even these do not always insure perfectly uniform heating and are, besides, very wasteful of fuel.

In order to obtain perfectly uniform heating and consequent expansion, Mr. Mark W. Dewey, of Syracuse, N. Y., has devised a simple method, in which the heating effect of the electric current is employed to good advantage. The apparatus by which this is accomplished is shown in the accompanying illustrations, Figs. 1 and 2, which show the same in plan and section, respectively. As will be seen, a converter, *B*, has its primary connected to a source of alternating current, which can be regulated by means of a rheostat. The terminals of the secondary coil are connected by flexible low-resistance conductors with adjustable clamps, *D* and *D'*, of good conducting material. These clamps are attached to the tire and are adapted to hold it so as to make good electric contact with the same at two points equidistantly apart in the circumference of the tire, so that the resistance of the tire will be equally divided between the two clamps to form two paths for the currents. The object of thus equally distributing the clamps on the hoop or tire is to heat the same uniformly throughout its circumference; for if the clamps were applied to the tire so that a short portion of the same was between the clamps on one side and a long portion on the other side, and if the tire were of a uniform size in cross-section throughout, a greater part of the current would pass through the short portion on account of its small resistance compared to the long portion; and consequently it would heat the short portion more than the long portion in proportion to the difference of resistance in the two portions of the tire. If a small difference of resistance exists between the two portions, however, the difference of heat in the two parts may be nearly imperceptible and immaterial. The tire rests upon a table of non-conducting material.

The operation of the apparatus is almost self-evident. The heavy currents generated in the secondary of the converter being led to the tire, it passes through both branches of the same, heating it uniformly up to the desired temperature, when the current is shut off by the switch.

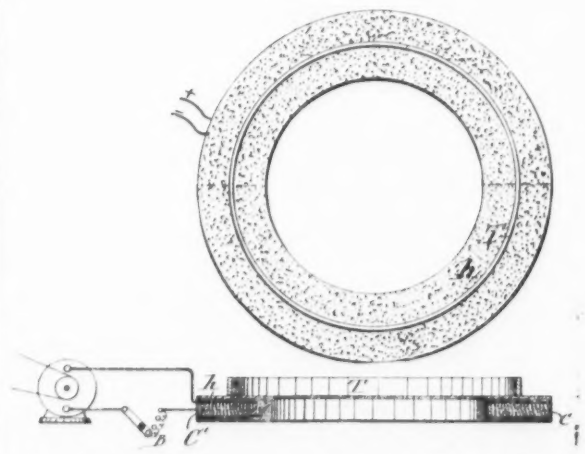
Another apparatus designed for the same purpose is that shown in plan and section, respectively, in Figs. 3, and 4. Here, it will be noticed, the primary coil *C'* of the transformer is made as large as the tire, or large enough to form a bed to support various sizes of tires. Suitable insulating and heat-non-conducting material, *h*, is interposed between the coil *C'* and tire *T*, which latter itself forms the secondary coil. This insulation is employed for the purpose of preventing the heat of the tire from burning the insulation around the wire of the coil *C'*. As the tire alone forms the secondary circuit, the heating-current circulates only in the tire, and the other parts forming the secondary circuit in the other apparatuses are dispensed with, and the apparatus is thus greatly simplified.

Dynamo Mishaps.

To the Editor of The Electrical World:

SIR: Noticing articles in your issue of March 30 and April 27, on "Dynamo Mishaps," I send you the following bit of experience for the benefit of those who have to deal with alternating current machines, separately excited.

I have noticed in the last few nights in running that I had much difficulty in keeping the lamps up to their candle power, even when steam pressure was constant. The exciter, shunt wound, seemed to work splendidly and the load on the alternator was about as usual. I found the last few nights that I had almost to swing the resistance entirely out of the shunt fields of the exciter and at



FIGS. 3 AND 4.—EXPANDING TIRES BY ELECTRICITY.

the same time to cut all resistance out of the alternator coils in order to keep the lamps up to candle power. My lines were all free from troubles and so was the exciter to all appearances.

But last night I found I could not start my exciter. I tried everything in the line of testing for "open circuit," "loose connections," "iron connections" and "copper dust connections," but could not discover any trouble. So as a last resort I tested the field cores of the exciter, and found that they were demagnetized. I then took a common ordinary Diamond carbon battery and charged the field core of the exciter by passing a current through the shunt coils, and found that I could start up immediately.

I infer that the current from the alternator in some manner not known, leaked back to the exciter and demagnetized the field cores. If any of your readers can explain the reason I would be much obliged.

E. L. CASTLE, Supt. and Elect.

GRAND FORKS, North Dakota.

Secondary Batteries.*

BY WILLIAM HENRY PREECE, F.R.S.

Secondary batteries are often called accumulators and storage batteries, and the general impression is that they accumulate or store that which is called "electricity." What is accumulated or stored is, however, energy in its chemical form. A *secondary* battery is really a battery pure and simple, but it differs from a *primary* battery in this, that the chemical character of the conductors or plates and the electrolyte in which they are immersed has been excited by an electric current which has passed through them continuously for some time, while in a primary battery the chemical affinities exist in the materials of which the cell is composed. In the language of the distinguished American, Judge Coxe, "A secondary battery is one which gives no electricity of itself, but is active only when rendered so by a current from an independent source."

Secondary batteries have become an essential feature of every properly equipped isolated electric light installation, not only for the regulation of electric currents and the maintenance of uniform electromotive force, but to give a store of energy to draw upon at night and when any accident or failure occurs. They are also employed for the distribution of electrical energy from central stations. They are used for ship and for train lighting, and they seem destined to solve the important question of economical traction on our tramways. They are much used in telegraphy. They have passed through a very severe ordeal for seven years' practical development in the face of determined opposition and in spite of the prejudice resulting from disastrous commercial speculations and from the non-fulfillment of over-sanguine hopes and hasty utilitarian anticipations.

The father of lead secondary batteries, in a scientific sense, is the eminent French electrician, Gaston Planté, but the final stroke that made the apparatus a real practical instrument was the discovery of Faure, who showed that the application of oxides of lead in the form of a paste or cement on the surface of the lead supports, so hastened the process of formation of the plates that the battery was made a commercial and valuable instrument. Sellon, Volckmar, Swan, Julien, Parker, King, Drake and Gorman have added so much to the mechanical details, and have done so much to remedy defects and remove faults of construction, that all we want now is to crystallize into practical language the teachings of experience.

My house has been lighted by these batteries since March, 1884, now five years ago. I commenced with seventeen Planté cells, manufactured by Elwell, Parker & Co., of Wolverhampton, charged by currents from a dynamo driven by a 2 horse-power gas engine; but after two years of experimenting I selected twenty-six cells of the 15L E.P.S. type, with which form of cells I am now working. Their value can be illustrated by the following fact: On March 30 my gas-engine broke down. I quite forgot to give notice to the makers to send down men to repair it until six days had elapsed. It took five more days to repair the engine, so that for eleven days I had not been able to re-charge the cells; but during all these days the light never failed, and we were not in any way inconvenienced. The useful capacity of my cells is 330 ampère-hours, and my nightly consumption is now about 30 ampère-hours. This was a very good test of the efficiency of the cells, for I obtained from them nearly all the energy they could usefully give. Only two cells were really exhausted during this time, but as I had two spare cells to replace them, their exhaustion did not cause me any inconvenience. The E. M. F. fell to 1.8 volt per cell and the light in consequence was not so brilliant as usual. A good practical test of the efficiency of a battery like this is better than any isolated tests on single cells.

The illumination of this hall (Society of Arts) is regulated by 58 E. P. S. cells, of 13L type, an obsolete form, which are used, when the hall is not open, to light the secretary's and the public offices. They have been at work here since January, 1885, and have given no trouble and very great satisfaction.

TYPES OF CELL.

There are several kinds and types of cells in use at the present day, but the principal ones supplied in England are by the Electrical Power Storage Company and by Elwell-Parker Company (Limited). The E. P. S. cells are of several patterns:

L—Stationary cells used for electric lighting, motive power and general purposes.

T—Portable cells used for tram-car and launch propulsion.

C—Portable cells for railway carriage lighting.

Of the *L* pattern the following are the sizes issued:

No. of plates.	Weight.	Maximum rate of discharge (ampères).	No. of 10 candle-power lamps (26 cells).	Capacity (ampère-hours).
	Lbs.			
7 *L*....	68	13	21	130
11 *L*....	101	22	36	220
15 *L*....	128	30	50	330
23 *L*....	211	47	76	500
31 *L*....	265	64	100	660

There is always one more negative plate than positive.

E. P. S. TYPE, 1888.

The plates of each cell are divided into the positive and the negative, in each case a pure lead grid being cast for retaining the paste-oxide, $8\frac{1}{2} \times 9\frac{1}{2} \times \frac{3}{16}$ thick, and weighing 5 lbs. The perforations or openings of the positive plate are filled with minium, while those of the negative plate are filled with litharge. The plates so prepared are then subjected to powerful currents for several hours, when the litharge (PbO) is reduced to spongy lead (Pb), and the minium and red-lead (Pb_3O_4) become lead peroxide (PbO_2). There is thus economy in reducing the lower oxide and in peroxidising the higher one. Many attempts have been made to manufacture the grids of inoxidisable alloys, such as an alloy of antimony and lead, to which mercury is sometimes added, but so far nothing seems to be superior to the pure lead itself. The principal defect has been that of buckling or deforming, and this is supposed to be due to irregular oxidization, but no clear explanation has yet been given of the remarkable way in which lead plates curl and curve under the influence of electrolysis. Plates do not buckle when they are properly treated. It is the rough handling of cells—calling upon them to do more than they were designed for, neglecting to maintain the level of the liquid and its density—that principally lead to deformation, disintegration, and also short circuiting from the paste falling out in plugs and resting across the plates. The plates are now fixed three-eighths of an inch apart, a sufficient distance to allow any pellet that may fall out to drop harmlessly to the bottom of the cell. This distance can be increased with advantage.

The pellets of paste are now made considerably smaller than was the case at first, and this has been done to hasten the period of formation, and to render the whole of the pellet active, which was not always the case with the larger pellet, for their centres were often found unformed, and therefore idle.

The negative plates of each cell rest on toes or blocks, and are maintained $1\frac{1}{2}$ inches clear of the bottom of the cell, and they suspend the positive plates by lead bars running along each side of the negative section, on which ebonite supports carry the positives. All the plates of each kind of each cell are welded or burnt on to a broad lead strip, to which either a terminal is attached, or which is burnt on to the strip of the next cell.

The "L" cells, for fixed permanent installations, are of glass, but for ship, tram and train purposes they are generally fixed in wooden boxes, rendered water-tight by lead, marine glue, or ebonite linings. Glass is much preferable to wood, or to any opaque substance, for it is very useful to see how the plates and their packing are behaving. Elwell Parker introduced a cell made of an inoxidizable alloy, but it has not been received with favor.

Glass has this advantage, that it is an excellent insulator, though owing to its hygroscopic tendency it has been found necessary in some cases to mount the cells on oil cups—a plan that is always necessary with wood and metal boxes.

The electrical leakage from glass cells when the acid spray is checked is very small indeed. They retain their charge unimpaired for months. It is, however, a good plan to paint the glass over with paraffin or vaseline occasionally. It checks leakage and prevents the acid from creeping.

ELWELL PARKER CELL.

The form of cell supplied by Elwell-Parker differs in several details from the E P.S. pattern, though it is of the same type. The plates are held together by side frames of wood or vulcanite at the edges so as to knit them together very firmly and prevent buckling. The whole frame of the largest size can be lifted in and out by a crane with ease. The negative plates are made in a way which prevents blistering, a defect in the E.P.S. plates, and the grids are burred in a way which prevents the pellets from dropping out. This process, due to Messrs. Drake and Gorham, is an important improvement.

CAPACITY.

The capacity of a cell is the amount of energy it will accumulate and usefully restore. It is measured roughly either in ampère-hours or in watt-hours. The latter is the more accurate if the fall of E. M. F. is carefully noted, but if the E. M. F. is maintained fairly constant by not running the cells too low, the former is equally practical and more common. The average type of cell, such as the stationary E. P. S. pattern, gives a useful capacity of 4 ampère hours per pound of plates complete. I have had a cell (Fitzgerald's lithanode) which gave a return as high as 5.7 ampère hours per pound, while the Planté type rarely exceed 2 ampère hours per pound. The portable form used for traction purposes gives 5 ampère hours per pound, but this is only because the plates are much lighter.

EFFICIENCY.

The efficiency of a cell is the ratio between the energy taken out of it to the energy put into it, and the useful efficiency is usually taken from the number of ampère-hours discharged when the E. M. F. falls 10 per cent. in magnitude. This figure is a very variable quantity, for it depends very much on the current density; that is, upon the number of ampères per unit of surface—one square centimetre—of plate. The following experiment on a small cell illustrates this point:

Current density.	Ampère-hours.
.013	44.6
.048	36.5
.09	30.2

The ordinary current density, which should not be exceeded in practice, is .01. This means that the maximum output should not exceed 4 ampères per positive plate.

A cell will discharge many more ampère-hours than are given by this useful efficiency, and if the discharge be taken with a very small density the efficiency may reach a very high figure. Thus 95 and 98 per cent. have been obtained from small cells slowly discharged. The efficiency of a cell therefore varies with its rate of discharge. If the efficiency with an output of 5 ampères be 90 per cent., it will be only 50 per cent. with a discharge of 40 ampères. Batteries drop in E.M.F. if the rate of discharge is high or the current density great. They should, therefore, be discharged at a slow rate. The most general maximum rate is found to be that which discharges a cell in ten hours. Thus the discharge of 15 L cells should not exceed 30 ampères, nor that of 31 L cells 60 ampères.

It is sometimes thought that because the E.M.F. in charging is 25 per cent greater than in discharging, there must be a loss of energy to that amount, but the fact is this loss of E.M.F. is compensated for by gain of current, owing to the reduction in the internal resistance of the cell. The internal resistance of a cell, which is normally about .0003 ohm per positive plate, diminishes with the strength of the current of discharge, and, therefore, it is possible to get nearly all of the energy out of a cell that has been put into it. The efficiency of a secondary battery increases with the lightness of the load put upon it, and in this respect it possesses a great advantage over that other transformer of electric energy, namely, the secondary generator of Gaulard.

It has been the practice to place the plates in a cell very much too close to each other. This not only favors short circuiting, but it prevents the free circulation of the electrolyte. Recent experiments have also shown that efficiency has also been improved by increasing the distance between the plates.

THE ELECTROLYTE.

The character and the quality of the electrolyte used in secondary cells has scarcely received the attention it deserves. Hitherto scarcely anything but a solution of sulphuric acid has been employed. Experience seems to show that the best solution to use before charging is one which has a density of 1.150. Such a solution in a 15 L cell, when fully charged, will acquire a density of from 1.210 to 1.220, and it is customary to maintain the density of the cells somewhat between 1.170 and the higher figure. One of the great troubles with secondary cells that are imperfectly and improperly treated is the formation of the white sulphate of lead that is frequently seen upon both plates. In fact, it is the root of nearly all the ills that these cells are heir to. There are many ways of getting rid of this sulphating. The plan used by Mr. Sayers, the engineer in charge of the St. Pancras Hotel installation, is described by him as follows:

"Our battery of 120 15 L cells was rather badly covered with sulphate of lead. At first I simply charged them with the ordinary maximum charging current, 30 ampères, when each cell on becoming full would give about 2.5 volts. The sulphate, however, did not apparently move. I then tried charging with 40 or 45 ampères for a few weeks, and the change in the look of the plates—of the peroxide plate chiefly—was considerable. They began to exhibit patches of the well-known plum-colored peroxide, and nearly all had the appearance of a peroxide plate covered with a lace-work of sulphate of lead. This lace-work, also, soon nearly entirely disappeared, and the majority of the plates are now looking very well. The E.M.F. of each cell, with 40 ampères charging current, is about 2.7 volts when the cell is milky. I have thought that this result was due either to the fact—if it is a fact—that sulphate of lead requires more than 2.5 volts to decompose it thoroughly—say 2.6 volts—or that the large quantities of nascent hydrogen attack the sulphate and combine, making sulphuric acid and lead."

It occurred, however, in 1886, to Mr. Barber-Starkey, of Aldenham Park, near Bridgenorth, to see if carbonate of soda in the presence of lead had any beneficial effect upon plates liable to sulphating. The result was very satisfactory; all traces of sulphating disappeared. He treated his own cells in this way, and the effect was so decidedly advantageous to all appearances that I determined, after careful inspection and inquiry, to make an exhaustive experiment that should determine the question, and at the same time settle the best proportion to use. Six new 15 L cells of the Elwell-Parker make were taken, and they were charged with solutions in the following manner:

No.	Sulphuric acid.	Sulphate of sodium.	Water.
1	5 pints.	5 pints.	15 pints.
2	5 "	4 "	16 "
3	5 "	3 "	17 "
4	5 "	2 "	18 "
5	5 "	1 "	19 "
6	5 "		20 "

The sulphate of sodium solution was prepared by first making a saturated solution of carbonate of soda (ordinary washing soda), and then adding thereto sulphuric acid until the effervescence ceased. The cells so prepared have been charged and discharged, and watched with great care from May 1, 1888, until the present day. We, therefore, have exactly twelve months' experience of their behavior, and there can be no doubt as to the beneficial result. The solution marked No. 5 is that which has given the best results, and after about six months' experience of its behavior two complete sets of 52 No. 23 L cells were charged, the one with the ordinary sulphuric acid solution of 1.175 density, and the other with sulphate of sodium solution of 1.225 density. Six months' experience of these two sets has confirmed the result that immense benefit is to be derived from the sulphate of sodium solution. There has been no evidence of buckling, there has been little or no scaling. The bottom of the cells are nearly as clean as when they were first discharged, while the bottom of those charged with the sulphuric acid solutions have the usual accumulation of oxides of lead. Two cells were also and at the same time charged, the one with the sulphuric acid and the other with the sodium solution, and very careful tests of these two cells show that the addition of soda does not impair either the E.M F. or the internal resistance, nor does it diminish the output of the cells. I have, therefore, come to the conclusion that the addition of soda has a distinct beneficial result, and it is my intention to use it invariably in future. The cells so provided remain in splendid condition. They can be left for months without developing any trace of sulphating or even of loss of charge. Carbonate of soda thrown into a badly-sulphated cell unquestionably leads to the rapid removal of the sulphate of lead, and this is supposed to be due to the fact that a carbonate of lead is formed which is easily reduced and always produces beautiful deep puce-colored peroxide of lead.

Mr. R. Davids writes, Jan. 18, 1889, to me from Campinas, Brazil: "As might have been expected, the cells (which had been delayed in transit) were very badly sulphated, but after 24 hours' charging I gave them a dose of soda, which proved a *santo remedio*."

The electrolyte that I recommend for adoption is this: To a quart of saturated carbonate of soda solution add slowly, during continuous agitation, 12 fluid ounces of strong sulphuric acid; fill the cell with water 19 parts, strong sulphuric acid 5 parts, soda solution 1 part; total, 25 parts. The specific gravity of this electrolyte should be 1.210.

It is a mistake to use cells of too small a capacity for stationary purposes. This is usually done for economical reasons, owing to the capital expenditure involved in purchasing cells. Twenty-six 15 L cells cost £78, and the same number of 23 L cells cost £117, but I believe it to be true economy to expend the additional £39. Greater efficiency is obtained out of the larger cells now that soda has prevented injurious sulphating, for you are not limited to a minimum current as you are with the sulphuric acid solution. Small charging and discharging currents mean not only greater efficiency, but greater durability of the plates. Secondary batteries used for telegraphy show no sign of disintegration. It is overtaxing cells that destroys the plates. Mr. Barber-Starkey's cells at Aldenham Park have now been in use for three years, and to all appearances they are quite as perfect now as when first set up.

MAINTENANCE.

The chief secret of the successful working of a set of secondary cells is careful and regular attention to their behavior, and the immediate remedy of any defect that may develop. They require daily testing and inspection.

* Paper read before the Society of Arts, May 1, 1889.

My battery is tested every morning for E. M. F. by means of a Cardew's voltmeter. If the total number of volts divided by the number of cells is not over 2 per cell, each cell is tested separately by a portable Walsall voltmeter, graduated to tenths of a volt, until the defective cell is found. This has very rarely happened—in fact, only once during the past twelve months, when a plugging fell out, rested between the two plates and short-circuited the cell.

Six cells are also tested every morning for density by a hydrometer, which is recorded in a book. The six cells are changed every month, so that each cell of the battery passes through this ordeal three times a year. The regular rise and fall of the specific gravity of a cell is the very best criterion one can have of its good working. I cannot do better than transcribe the record of one week's testing.

"GOTHIC LODGE" ENGINE ROOM.—28 E.P.S. CELLS.

Date.	Current.	E.M.F.	Cells (Density).*				
			8	14	18	20	26
April 24	—	57.5	1,210	1,215	1,190	1,225	1,225
" 25	—	57.5	1,210	1,205	1,185	1,220	1,220
" 26	—	57	1,205	1,195	1,180	1,215	1,215
" 27	Charging.						
7:30 a m	26½	60	1,200	1,190	1,175	1,210	1,210
10:00 "	30	64	1,205	1,195	1,180	1,215	1,215
12:00 "	31	67	1,210	1,200	1,185	1,220	1,220
2:00 "	31	69	1,210	1,205	1,190	1,225	1,225
4:00 "	31	70	1,210	1,210	1,200	1,225	1,225
April 28	—	57.5	1,210	1,205	1,195	1,225	1,225
" 29	—	57.4	1,205	1,200	1,190	1,220	1,220

* The density of the cells requires to be equalized periodically.

The normal density when the cells are charged should be 1.220. They fall 1 for every 5 ampère-hours taken out, and when they reach 1.150 they are exhausted. The density is thus a record of the energy that has been taken out, and of that which remains in.

Occasionally I test them for internal resistance (ρ), both when charging and discharging. In the latter case the discharge current into the house is regulated by lamps to give 10 ampères when the E. M. F. (E_1) at the terminals is read. The E. M. F., when the ends are free (E_2), is also read. Then:

$$\frac{E_2 - E_1}{10} = \rho.$$

I make the current 10, for the internal resistance varies with the current,* and by always using the same current I have an accurate comparison. The internal resistance of my 15 L cells is usually .0012 ohm per cell when discharging, and .005 when being charged.

When a cell becomes defective by short circuiting or any other cause, the plates are taken out, their faces scraped and straightened, the solution cleared, and the cell thoroughly cleaned. The cell is always benefited by such a process, for the cleaned cell is always the first to come up to the charge by as much as 1½ hour,

The cells in this building have been very carefully tended during the four years they have been at work. Only three sets of positive plates have been renewed.

In charging cells, there are three distinct indications that the cell is fully charged.

1. The E. M. F. suddenly rises up to 2.5 volts per cell.
2. The hydrometer indicates 1.220.
3. The electrolyte becomes milky by the fine bubbles of gas that float in the disturbed solution during their gradual ascent to the surface and escape into the air.

The rise of bubbles of gas to the surface and their bursting scattered a considerable amount of acid spray about in the battery room, which was injurious to metals and apparatus; but Mr. F. Higgins, Memb. I. E. E., showed how to prevent this by covering the cell with a fine net or with calico. Glass plates are now much used instead of calico, but I have adopted Mr. Henry Edmunds' plan of pouring upon the surface of the solution melted paraffin, which solidifies and coats the surface with a uniform thin layer of what looks like ice.

It is necessary to be cautious in approaching cells with naked lights when they are being charged. There are several instances of explosion and injury to person in consequence.

The chief defect of the negative plate is that the plugging scales and falls off in thin flakes. This, in the recent types, falls harmlessly to the bottom, but it should not happen at all, and it is due either to imperfect material or to hasty formation. The negative plate should certainly last for ten years. The positive plates also disintegrate, and to a much greater extent. The disintegration of the lead peroxide seems to be a necessary consequence of the action of the cell. It varies with the rate of discharge. If the cells be worked heavily it occurs rapidly, but if the maximum rate of the output of about four ampères per plate be adhered to, the duration of the plate may be taken to be three years. The decay of the positive plate seems to occur almost entirely in the lower half of the plate, and this is probably due to the greater density of the solution favoring unequal distribution of current.

CENTRAL STATIONS.

The secondary battery lends itself admirably under certain circumstances to the economical distribution of electric currents from central stations. It is possible to lay down a long main circuit of small dimensions, conveying a direct current of high E. M. F., which at different points can charge a secondary battery of a small number of cells, so as to "transform" the dangerously high E. M. F. into one of a low and harmless character in the building to be illuminated; in fact, this is now being done in Chelsea by two different companies. The one company, the Chelsea Electricity Supply Company, is acting under the statutory powers of a Provisional Order, and it distributes its currents to the houses from sub stations, where the batteries are kept, and maintain a continuous supply of electric energy. Each sub-station, of which there are three, supplies current for 2,000 30-watt 10 candle-power lamps. There are 265 31 L cells, divided in two sets of groups of 53. Each set is charged separately and alternately in series from the central generating station. While one set is being charged the other is supplying currents to the consumer. The main charging current of 60 ampères has an E. M. F. of 500 volts per distributing station, or 1,500 volts for the present circuit; and the secondary discharging supply into the houses has a pressure of 100 volts. This system of distributing currents from batteries has many advantages. The currents being direct are available at once for motor purposes, as well as for lighting. The currents being so steady and uniform add to the durability and life of the lamps. The supply being continuous day and night, it is always available, just as is the light from gas. The distributed currents being of low E. M. F., absolute safety to person is secured in such a system. The engines at the central station, being always worked at full loads, can be worked under their most economical conditions, and as they can be worked continuously throughout the twenty-four hours, a minimum capital expenditure in engine plant is necessary. It has already been pointed out that the efficiency of the battery is not much affected by variations of its own load, and that whether one lamp or 100 lamps be used it is not of much consequence to the cells; in fact, the efficiency of the lighter load is the highest. On the other hand, it must be pointed out that there is a considerable capital outlay required in batteries. The depreciation of the cells is very considerable, and there is an appreciable loss of energy at each transforming point. The maximum efficiency of batteries in practice rarely reaches 70 per cent., while less than 15 per cent. for depreciation can scarcely be allowed with prudence. The batteries for 1,000 lamps cost £1,325, or 27s. per lamp. The reliability, constancy and permanence of the light from batteries compensates for many another evil. The other company in Chelsea—the Cadogan Electric Supply Company—places the batteries in the houses, and charges 1,000 E. P. S. 35 L cells over a circuit of nine miles.

There is a central station in Detroit, in the U. S. A., also distributing by batteries, and giving great satisfaction.

The Kensington Court Central Station, established by Messrs. Crompton & Co., and that at Whitehall Court, also use secondary batteries, but the batteries are in the stations and not in the houses. They are used more for regulation and for reserve force purposes than for distribution.

There is also a large central station at Vienna, and one at Darmstadt of the same character.

An extremely ingenious mode of distribution has been proposed by Mr. Henry Edmunds. The battery is divided into four groups. Three groups are jointed in series, and supply energy to the house, while the fourth group is in the main being charged. These groups constantly and continuously change places every three minutes by means of an automatic switch. A third of the battery is, therefore, always being charged, and this means that only one-third engine-power is needed at the central station, and only one-third of the E. M. F. on the charging main. Mr. Edmunds' automatic distributor is an extremely ingenious apparatus, but it has not yet received the test of practical trial, though the sooner it does so the better.

Mr. Preece concluded his paper with a few remarks upon the application of secondary batteries to electric traction, portable lamps and telegraphy.

* Preece, *Proc.* Roy. Soc., May 6, 1885.

Legislation Affecting Electric Light Interests.

At the Chicago meeting of the National Electric Light Association, a national committee on State and municipal legislation was provided for, with Mr. A. R. Foote, of Cincinnati, as chairman. Since then that gentleman has been actively at work, as the following communication we have received from him will show:

The resolution creating this committee was adopted so near the close of the Chicago convention, that little opportunity was afforded in which to make up its membership or mark out its course of action. The first problem has been how to secure a committee of able men identified with operating companies, each of whom would represent his State in whatever way might become desirable, in giving effect to the plans of the committee. To secure the best results and to avoid misunderstandings, I printed a list of all names proposed and sent two copies to the officers and the executive committee of the association, with the request that they would retain one copy for their information and return the other with their suggestion.

It became quickly apparent that some persons were not members of the association, whom it would be very desirable to have associated on the committee. In view of this it was thought best to nominate such persons and invite them to become members of the association at the time they were informed of their nomination as members of the Committee for their State. As soon as a majority of the lists were returned, a new list was prepared and sent to the same persons. When a majority of the second lists were returned, a third list was prepared for the information of the persons nominated. It is as follows:

A. R. Foote, Cincinnati, Ohio, *Chairman.*
Alabama—Wm. Gesner, Montgomery.
Arkansas—Dean Adams, Little Rock.
California—Geo. H. Roe, San Francisco.
Colorado—C. H. Smith, Denver.
Connecticut—J. C. English, Bridgeport.
Dakota—Judge Stone, Fargo.
Delaware—C. Newbold Trump, Wilmington.
Florida—G. Stuart Smith, St. Augustine.
Georgia—Judge H. E. W. Palmer, Atlanta.
Illinois—S. L. Nelson, Champaign.
Indiana—J. B. Caren, Indianapolis.
Iowa—Thomas Officer, Council Bluffs.
Kansas—M. Beebe, Hutchinson.
Kentucky—A. H. Barret, Louisville.
Louisiana—M. J. Hart, New Orleans.
Maine—Geo. Westcott, Portland.
Maryland—Arthur J. Steuart, Baltimore.
Massachusetts—F. A. Gilbert, Boston.
Michigan—J. E. Lockwood, Detroit.
Minnesota—S. S. Leonard, Minneapolis.
Mississippi—H. P. Hawkins, Greenville.
Missouri—J. A. Corby, St. Joseph.
Nebraska—Rigan, Omaha.
Nevada.
New Hampshire—Alonzo Elliott, Manchester.
New Jersey—Wm. H. Moore, Plainfield.
New York—E. A. Maher, Albany.
North Carolina—D. A. Tompkins, Charlotte.
Ohio—A. R. Foote, Cincinnati.
Oregon—P. F. Morey, Portland.
Pennsylvania—A. J. De Camp, Philadelphia.
Rhode Island—M. J. Perry, Providence.
South Carolina—Geo. B. Edwards, Charleston.
Tennessee—Robert L. Morris, Nashville.
Texas—David Hall, Galveston.
Vermont—J. M. Francisco, Rutland.
Virginia—Maurice B. Flynn, Richmond.
West Virginia—Geo. B. Garden, Wheeling.
Wisconsin—Henry C. Payne, Milwaukee.
Washington, D. C.—Geo. Truesdale.
Washington Territory—John H. Houghton, Tacoma.

This history shows that the necessary thing now to be done is for all who are interested in the Association, especially those who nominated the persons named, to use the full strength of their influence to secure their acceptance of the appointment, and thus complete the organization of the committee. While desiring most earnestly to secure this end, the fact should not be lost sight of that it is better to have a vacancy than a name that represents only an address on which time and money must be expended, without securing any yield of co-operative action.

In order that the nominees for the committee may be advised as to the course the committee will be expected to pursue, I prepared the following:

Plan of Work.

1. An examination will be made of the laws in each State to see in what particulars, if any, the electrical industry can be benefited by securing any practicable change in such laws.

2. All bills, affecting in any way the interests of the electrical industry, that were introduced at the last session of the legislature of any State, but which did not become laws, will be examined to ascertain the *tendency of* legislation and to see if it is desirable that they should be passed.

3. Whenever any legislation is desired in any State, or if legislation is proposed that is not desired, copies of the bill proposed will be furnished to the chairman of the Committee. He will then furnish the member of the committee for that state such data, arguments and citations as he may be able to provide, to enable said member to place information in the hands of proper persons through whom the desired result may be secured.

4. All work done in one State will be kept in printed form, so that it can be used at once in any other State. The work will thus become accumulative, and of such a thorough character as to be practically irresistible.

5. No legislative measure or economic principle will be advocated in any manner in the name of the committee without the approval of a majority of the whole number of its members, nor will the committee undertake to secure legislation in any State without the approval of the member for that State, and then only when sufficient preparation has been made to render success a reasonable certainty.

6. Each member of the Committee will recommend to the chairman an attorney for his State, who will receive and preserve for reference, copies of all documents published or approved by the Committee, to the end that if at any time it becomes necessary to employ counsel in that State, or if any special interest requires such service, said attorney will have the desired information and can represent the Committee, or such special interest as may wish to employ him, and have at his command much of the data necessary to familiarize himself with the subject.

7. All other considerations being equal an attorney residing at the capital of the State will be preferable.

8. The funds of the Association are not to be used for any of the expenses of this committee in any manner whatever.

Printed copies of the above were submitted to the officers and executive committee of the association, and with them copies of the letters to be used in inviting the persons nominated to accept the appointment as a member of the committee.

In this manner the time since the adjournment of the Convention has been occupied in forming the committee, and giving shape to an agreed basis for its work. No argument is required to prove that the results which this committee may achieve will be of great value to all who are interested in any way in the electric industry. It ought to be as readily understood, that the principal limitation upon its influence and usefulness, will be fixed by the manner in which those co-operate with and sustain it whose interest it is designed to serve. None who fail to co-operate with this committee, should ever afterwards be surprised if their isolated efforts prove ineffectual to defeat or change undesirable, or to obtain desirable State or municipal legislation.

International Congress of Electricians at Paris.

We have already published the programme of the International Congress of Electricians, which will be held in Paris, beginning on the 24th of August next, and continuing for eight days. Respecting the objects of the Congress, M. E. Mascart, president of the Committee of Organization, has issued the following letter:

"The International Congress of Electricians held at Paris in 1881 marks an important date in the history of electricity. The establishment of the practical units has had a most important and far-reaching influence on the development of the science and industry. The great rapidity and ease with which the decisions of the Congress were accepted in the workshop as well as in the laboratory, demonstrate the utility of large scientific gatherings where all the most competent may unite in their efforts for the common good.

"The International Exhibition of 1889 offers a natural occasion to continue and to complete the work of 1881; not that the new congress will have to treat of problems of an order as general, or as high, but many questions still remain upon which an understanding or at least an exchange of views is desirable. In the programme which it has prepared, the Commission of Organization has not pretended to indicate all the debateable points, and still less to impose any limits on the field of activity of the Congress. It has only desired to call attention to those departments which appear to it to be of the most general and immediate interest. We believe that we express the unanimous sentiment of electricans in putting among the foremost questions the following: Practical measurement of electrical energy in all forms; measurement of the current in absolute values with a standard which is easily reproduced; electric meters for continuous and alternating current; practical measurement of light; determination of the constants of a machine from the commercial points of view, etc.

"We hope that the scientists and manufacturers who may have contributed to the progress and applications of electricity, and all persons who are interested in this new branch of human activity will answer our appeal by con-

tributing and giving to this meeting the importance and authority of that which preceded it."

According to the rules adopted for the regulation of the Congress, all those may become members who have signified their intention to the President of the Commission of Organization before the opening of the session, or who may register during the continuance of the same, and on payment of a fee of 20 francs. All members of the Congress will receive a card, which will be delivered to them by the Commission of Organization, and which will be strictly personal and not transferable. A full account of the proceedings of the Congress will be published by the aid of the bureau, and each member will be entitled to a copy of the printed proceedings. Those desiring to attend are requested to address M. Mascart, President du Commité d'organisation du Congrès, 44 Rue de Rennes, Paris.

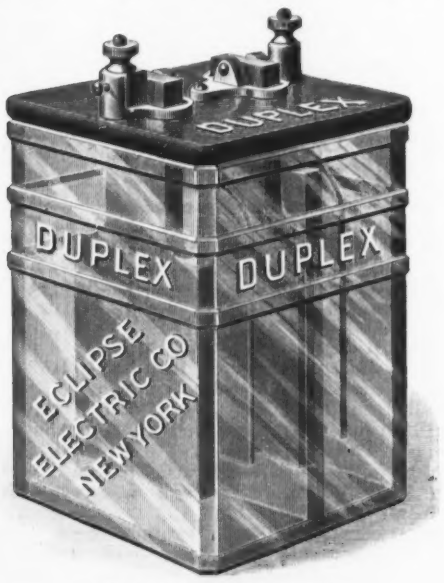
Members who send in their subscriptions will receive a personal card and a series of notices relating to the programme to be followed.

A Lecture Experiment Illustrating the Effect of Heat on the Magnetic Susceptibility of Nickel.*

It is well known that nickel loses its magnetic susceptibility when heated, and that this loss occurs at a very much lower temperature than in the case of iron. This property is shown very neatly by a simple piece of apparatus designed by Mr. Bidwell. A small copper disc is suspended by means of two hooks and a pair of threads from a support, so that it can swing in its own plane, forming, in fact, the bob of a pendulum. A small bar of nickel projects on one side from the edge of the disc, and opposite to this nickel bar is a steel bar-magnet fixed in a horizontal position in such a way that when the nickel is in contact with the magnet the pendulum deviates slightly from the vertical. The copper disc is blackened in order that when heated it may cool again as rapidly as possible. When the apparatus is left to itself the nickel is attracted by the magnet and remains in contact with it. When the nickel bar is heated by means of a gas flame, it almost immediately loses its magnetic susceptibility and ceases to be attracted; it therefore swings away from the magnet in obedience to gravity. By the time that it is swinging back toward the magnet it has become cool enough to have regained its magnetic susceptibility, and is therefore again attracted by the magnet, but it falls away again almost immediately owing to its being brought into the flame. Mr. Bidwell states that if the flame is kept steady the oscillation can be kept up for some ten minutes. It forms an exceedingly pretty experiment for lecture purposes.

The "Duplex" Open Circuit Battery.

Quite a novelty in open circuit batteries has recently been brought out by the Eclipse Electric Company, of this city. The battery, which is illustrated in the accompanying engraving, consists of a glass jar made of heavy pressed glass about six inches high and four and one-half inches square. Its distinguishing feature, however, is a glass partition which divides the jar into two compartments or cells, all being made in one piece in a special mold. The cover carries the elements for two cells, having only two binding posts, as shown. The cover is made of a pressed



THE DUPLEX BATTERY.

and polished material in exact imitation of hard rubber, and the whole presents a neat appearance.

Deaths by Lightning in England and Wales.

At a recent meeting of the Royal Meteorological Society, a paper was read "On the Deaths Caused by Lightning in England and Wales from 1852 to 1880, as Recorded in the Returns of the Registrar-General," by Inspector-General R. Lawson, LL.D. The total number of deaths from lightning during the 29 years amounted to 546, of which 442 were of males and 104 of females. In consequence of their greater exposure, the inhabitants of rural districts suffer more from lightning than those of towns. It appears, also, that vicinity to the west and south coasts reduces the chances of injury by lightning, and that distance from the coast and high land seems to increase them.

*Abstract of a paper read before the London Physical Society by Mr. Shelford Bidwell, F. R. S.

The Telephone Amalgamation in England.

The arrangements for the proposed telephone amalgamation throughout England have been unexpectedly pulled up by the refusal of the Postmaster-General to consent to the proposal. No transfer of license can be made without his consent, and the telephone companies are therefore at a standstill. The idea that the Government may have to buy up the companies is supposed to be at the bottom of this move, the value of the system, if amalgamated, being greatly increased.

A Novel Cigar Lighter.

The accompanying cut illustrates a new form of an electric cigar lighter automatically controlled, made by the Novelty Electric Company, of Philadelphia. It can be attached to any form of gas burner, if fitted with a flexible tube and allowed to hang free. The action is exceedingly simple. By merely catching hold of the bulb at the base of the burner and lifting it to the cigar held in the mouth, the gas is turned on and at the same time ignited by an electric spark. Letting the bulb fall back into its former position extinguishes the light by turning off the gas. As an ornament it is very attractive. Every part is full nickel plated, and the workmanship is superior to that of most articles of this nature. The wires are all concealed and cannot get out of order by any ordinary treatment. Its life is practically infinite. A coil and two cells are furnished with each lighter, together with printed instructions detailing the manner of adjusting the device. The Novelty Company are the patentees and sole manufacturers.

Electrical Engineering at Princeton College.

At Princeton College, N. J., on May 17, President Patton made public the following announcement in regard to the new course in electrical engineering which will be instituted at the beginning of the next college year at Princeton.

Candidates for the degree of electrical engineering from this institution will be admitted to a course of special study, having that end in view and extending over two years, on passing satisfactory examinations in the following subjects: Mathematics, including trigonometry, analytical geometry and differential and integral calculus; physics, equivalent to the course at this college, and elements of chemistry. Ability to read French and German is desirable.

Students who have pursued the course in the academic department of the college through the junior year, and have taken the elective course in mathematics, and also students who have completed the junior year in the John C. Greene School of Science, will be admitted to this course.

The course will be full, and fully illustrated, both as respects electrical theory and the applications of electricity in the industries, such as electrical lighting, transfer of energy, electro-chemistry, electro-metallurgy, etc.

Examinations for admission will be held June 20 and 21 in Princeton and at other points where examinations are usually held.

Electricity on War Ships.

At a meeting of the Naval Institute held in Annapolis on May 17, Mr. S. D. Greene, electrician of the Sprague Electric Railway and Motor Company, read an interesting paper entitled "Electricity on Board War Ships."

The object of the paper was to bring to the notice of naval officers the extent to which electricity is being used for the transmission of power for commercial purposes, and to show how the same applications could be made to advantage on board of our new war ships in lieu of the auxiliary steam and hydraulic engines so largely used at present. The opening remarks were devoted to the question who should have charge of the laying out and installation of the electric plant for a ship. At present each bureau in the Navy Department has charge of the apparatus belonging to its department on board ship. Such an arrangement would obviously be most unsatisfactory in the case of the electric plants, and Mr. Greene dwelt with a good deal of force upon the necessity of having all the electric apparatus under one head, both in its designing and in its pratical operation. A bill was before Congress during its last session to appropriate a sum for developing electric motors for naval uses, and now that the motor was likely to be introduced so largely on our new ships it was most important that the office controlling the installation should be properly organized. The dynamo room, where a large plant is used, at once becomes one of the vitals of the ship, and hence must be afforded all the protection that the type of the vessel allows. Importance is attached to the necessity of having all engines and dynamos duplicates of each other and to the following requisites for the plant: Compactness, lightness, strength, efficiency and economy. By having several dynamos, each duplicates of each other, only as many may be run at any one time as the load requires.

Under the heading of the wiring and lamps several suggestions were made, based on experience gained ashore. The use of a lead covering on the wire to act as a mechanical protection was condemned on account of its liability to break when handling. As a substitute, it was suggested to use either an armored wire, such as is used in submarine work, or else a plain, bare wire, run in a continuous slate or porcelain trough.

The various classes of work done by the auxiliary engines of a ship were next enumerated in detail, and it was shown how motors could be used to advantage instead of steam or hydraulic machinery in each case and what type of motor was best suited for the particular work in question. Attention was drawn to the fact that an ammunition hoist had recently been put on board the Atlanta, operated by a motor, and that one of the gun-carriages of the Chicago was being fitted with a training motor and an elevating motor. These were the first two applications of their kind ever made, and their working would be watched with considerable interest by naval officers and electricians not only here in the United States, but also abroad. An ingenious hand control for the motor, devised by Lieut. B. A. Fiske, of the navy, is used in connection with these two applications. A striking contrast was drawn between the complicated task of running steam pipes all over a ship and the easy, simple operation of running electric wires. The superior economy and simplicity of operation of the electric motor over other forms of engines were also demonstrated, as the result of experience in the commercial world.

The advisability of increasing the number of search lights on our new ships was shown, together with the use of these lights for long-distance signaling. One of the latest electrical devices described was the new range finder invented by Lieut. Fiske. Its accuracy, as proved by elaborate tests, is something remarkable, and its general usefulness on board ship for taking bearings, distances, angles, etc., will be readily appreciated by all interested in the nautical profession.

The use of firing circuits for firing the main battery of a ship was strongly argued. In action, with the ship rolling, the gun captain must be able to fire his gun the instant the sights fall on the object aimed at, and electricity is the best known agent to accomplish this. In addition, there are times when a commanding officer will himself want to fire his whole battery simultaneously, and he can do so best by pressing an electric button.

Martin's Electric Thermocall.

Mr. Martin, of Boston, the inventor of the hydro carbon thermostat, has succeeded after a long series of experiments in devising a thermo instrument which, it is believed, will be appreciated by those using this class of apparatus.

MARTIN'S THERMOCALL.

The instrument in question consists of a brass spun case three inches in diameter, of neat and ornamental design, and a dial with a scale of degrees occupying the full circle from 35 degrees to 120 degrees, giving one-eighth of an inch space for each degree Fahrenheit. Thus it needs no close scrutiny to set the pointer at the desired degree.

The dial is covered by a double-thick glass, in which a hole is bored through the centre, with a pointer or hand on the outside of the glass, and provided with a stop on the glass at zero. The hand may be swung with impunity to or from the stop in either direction without injury to the mechanism.

Attached to the hand is an arbor passing through the hole in the glass and dial which connects with a simple

mechanism in the interior of the case and controls the thermic device. The case is also provided with two binding posts for the electric wires and a means for hanging the instrument on the wall. This instrument is designed for dwelling-house purposes in which an alarm for change of temperature is desired, also for controlling furnace regulators, hot house and drying rooms, for fire alarms and boiler rooms, for placing on the outside of tanks or cisterns for giving the alarm before the freezing point is reached, and many other purposes where a reliable thermo instrument is needed. It can also be practically used as a thermometer by turning the hand to the number on the dial at which the electric bell rings; in this capacity it registers temperature to within half of a degree.

Its sensitiveness is remarkable, for by setting the hand at a temperature of say 71½ degrees in a room the temperature of which is 71, one breath from the lips will cause the bell to ring.

Mr. Martin has also combined this instrument with a register regulator by which the temperature can be maintained at a constant degree automatically. Thus he fits up a house in which the cellar is at a temperature, in winter, of say 38 degrees, dining room, library and parlor at 70 degrees, and sleeping rooms at 50 or 60 degrees or any other desired temperature.

If it is desired to increase the heat in a 50° room to 70° or any other degree, the only manual work required is to turn the little hand to 70 on the dial, and the register controlling apparatus takes care of itself, soon attaining the heat required.

Where the thermocall is used only for fire alarm purposes, a reliable open circuit battery is preferred, one cell being sufficient. Where it is used to regulate temperature with nicety, two cells of gravity battery will be found preferable.

The apparatus is remarkable for its cheapness, and will no doubt enjoy a brisk demand.

Cheating the Circuits.

To the Editor of The Electrical World:

SIR: The writer would like to submit the following to the readers of THE ELECTRICAL WORLD: Would not the following idea if carried out in practice, be capable, of multiplying considerably the lighting power of a given electric current?

It is a well-known fact that the impression of the light upon the retina lasts a fraction of a second after the luminous source has been obstructed or destroyed. This being remembered, let us consider a current capable of feeding say 100 arcs. Now let us suppose that by some means this current could be thrown, say every $\frac{1}{100}$ of a second, into another circuit, and that during $\frac{1}{1000}$ of a second. The result will be that every $\frac{1}{100}$ of a second an electric wave of constant intensity will flow through the 100 arcs, making their light appear continuous. But in that way we shall have kept $\frac{9}{10}$ of the duration of the current, and its intensity being always the same, we can make it pass through 9 other different circuits of 100 arcs each during $\frac{1}{1000}$ of a second. By this arrangement we shall have transformed our constant current into 10 pulsatory currents feeding each 100 arcs—that is, in all, 1,000 arcs. We will in that way have multiplied the lighting power of this current by 10. By another system of pulsatory currents we might have multiplied it by another number.

The sending of the current through the ten circuits seriatim would be easily done by means of a properly contrived commutator. And as everybody could easily fancy one filling the requirements, no objection about it could be offered to the practicability of the method of lighting above suggested; neither would the intermittent character of the arcs be noticed so long as the intermittences so closely follow each other that the light would appear continuous, as is the case of arcs fed with alternate currents.

ALBÉRIC GAILLARD.

NEW YORK CITY.

We might say that the idea suggested by our correspondent is not new, having been often suggested before. Several patents have, we believe, also been taken out on such a system, among others by Edison.—EDS. E. W.

American Workmen and the Paris Exposition.

We have received the following from the Scripps League, which embraces the *Evening News*, of Detroit; the *Press*, of Cleveland; the *Evening Post*, of Cincinnati; the *Evening Chronicle*, of St. Louis; the *Echo*, of Detroit, and the *Sunday News*, of Detroit.

"One of the most extensive newspaper expeditions ever projected in this country is that which the Scripps League of Western newspapers will send out during the coming July. As Congress took no steps towards sending American workingmen to the Paris Exposition with a view to examining the advance of mechanical arts, this wealthy newspaper syndicate stepped into the breach and have undertaken the work which Congress overlooked.

"They propose to spend anywhere up to $25,000 in paying all the expenses of 50 American workingmen chosen from St. Louis, Cincinnati, New York, Boston, Detroit, Cleveland, Chicago and other manufacturing points. The details of choosing the men who are to accompany the expedition are now being arranged, and it is not unlikely that representatives from this city may be among those who accompany it. All trades will be represented, including ironworkers, carworkers, shipbuilders, carpenters, molders, printers, etc.

"Previous newspaper expeditions have gone to the North Pole and to the heart of Africa; but it is probable that no expedition has yet gone out which will afford such lasting benefit to a great class of people as this one.

"All workingmen's organizations are invited to correspond with the Manager Paris Expedition Scripps League, Detroit, Mich., concerning the selection of men."

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-177 TIMES BUILDING, NEW YORK, May 20, 1889.

Mr. C. J. Field, chief engineer and manager of the Edison Electric Illuminating Company, of Brooklyn, is pushing right ahead with his big undertaking, and I was surprised the other evening to note how far the underground work had already been carried. The building will soon be ready for the plant.

The Magnolia Anti-Friction Metal Company, Charles B. Miller, president, 74 Cortlandt street, have issued a new broadsheet circular giving a number of old and new tests bringing out the superiority of "Magnolia," and accompanied by various testimonials from different users, including the United States Navy and the German Government.

Okonite Wires in Paris.—As I mentioned in my last note, Capt. W. L. Candee has left for Paris to take charge of the Okonite exhibit at the Exposition there. The okonite wires are used also in the big exhibit of the Bell telephone. The Okonite Company also made a cable for the long distance telephone in use at the exhibition, consisting of three miles of twisted cable.

The Berryman Feed Water Heater and Purifier, B. F. Kelley, manager, 91 Liberty street, has now been in use about twelve years, and has made a splendid record. It is well known to electric light people, as one example will show. The Brush Company in this city have had them ever since they started, including one that went through the fire in the old station and is still in faithful efficient service. They are also used by the United States and Western Union companies in this city, as well as in a large number of isolated plants. Outside of New York they are found again in scores of electric light stations. The number is rapidly on the increase.

Eugene Munsell & Co., 218 Water street, miners and wholesale dealers in mica, who make a specialty of this material for electrical purposes, report a brisk demand. I find that mica is being very largely used now in connection with dynamo construction. It will be remembered that I mentioned in my notes some time ago that Mr. Hochhausen, the electrician of the Excelsior Company, gives it his preference as commutator insulation, and I have ascertained that it is used on all the Edison machines and the Sprague motors made at the big Edison Works at Schenectady. The firm carry a full assortment of all sizes of cut and block mica suitable either for construction or for repair work.

The E. S. Greeley & Co., 5 and 7 Dey street, who are perfectly omnivorous in the way of "gobbling up" desirable novelties, have just brought up something new and taking in the shape of a patent burglar alarm, which is about the neatest of the kind that I have seen. It does not involve the use of electricity, is thoroughly automatic, and can be carried about in the pocket. It resembles roughly an electric bell stood upside down attached to a double set of prongs, by means of which it is set on the floor and inclined against the door. Should the door be pushed or in any way tampered with, the alarm begins to give a decided warning of the intrusion. It is quite cheap, and is one of those things that make a big market for themselves. The house report activity in all their standard and familiar departments.

The Empire and Bay States Telegraph Company, with offices at 34 Broadway, this city, and 82 Water street, Boston, are now equipped and ready for business. They have the only opposition telegraph line between here and Boston, and their multiplex system is such as enables them to compete at a great advantage. Their apparatus is new throughout, and they have copper wires of low resistance. Besides doing a business of the regular telegraph nature, which, I note, is already opening up in fine shape, they will make favorable arrangements with inventors who wish to lease wires for the purpose of exhibiting or testing new electrical apparatus. The company is in good hands, Wendell Goodwin being president, W. H. Goodwin, Jr., manager, and J. W. McLaren general superintendent. I can cordially recommend the company to the consideration and patronage of your readers.

Edison Plants.—Mr. F. R. Chinnock, sole agent for the Edison Company in Long Island and New Jersey, has received a contract from the D., L. & W. Ry. Company to put in a plant to light the new and elegant depot at Hoboken. The plant will consist of 1,000 incandescent lights, 800 being of 16 c. p. to light the passenger depots, and 200 of 30 c. p. to light the train shed. The latter will be of the municipal or series system. He has also received a contract for a power plant which is to consist of two 3 by 12 New York Safety horizontal engines. The plant will be started about June 1. Mr. Chinnock has also closed contracts to light two new steamers of the Brooklyn Annex Company, which will have a 75-light plant. He has also sold a 100-light plant to the Elizabeth Oil Company, and has received a contract from the Eastern Distilling Company, of Greenpoint, L. I., for a plant of 200 lights.

The Sprague Electric Railway and Motor Company, through their representatives, P. A. Dowd & Co., of 239 Broadway, have lately closed contracts and orders from the Long Island City & Newtown Street Railway, of Long Island, for 8 cars and complete power station of the Sprague system, with Edison generators. Another contract is from the Troy-Lansingburg Street Railway, of Troy, for 15 cars and a complete power station. The Troy people have secured property along the river front for their station, and have given contracts for docks, etc., for the landing of coal. Mr. Dowd reports the following sales: Rose & Cohen, 1 h. p. motor for cloth cutting, one 3 h.p. for elevator and two 2 h. p. for sewing machines; Baeder, Adamson & Co., one 10 h. p. motor for elevator; Henry C. Kelley, 7½ h. p. motor for elevator; Roessler & Hasslacher, 3 h. p. motor for elevator; Smith & Sills, motor for elevator and machinery; Parke, Davis & Co., 5 h. p. motor for elevator, and Travers Bros., 10 h. p. motor for elevator.

The Anglo-American Electric Light Manufacturing Company, 423 West Thirteenth street, are busily engaged in making storage batteries. When I called in at their place one afternoon last week I saw several hundred complete batteries being tested. The plate of this battery is made by folding a thin lead plate in such a way that the active material can be put in the pockets or interstices made by the successive pleatings. One of the gentlemen representing the company in an official capacity showed me a number of cases, which he informed me contained complete storage battery outfit intended for the handsome Schermerhorn Building on Broadway near Wall street. The Anglo-American Company have a directorate containing a number of well-known men, including Mr. H. Steers, president of the Eleventh Ward Bank; Orrin Adams, president of the Commercial National Bank, and Col. E. D. Logan, president of the Logan Silk Mills, Auburn, N. Y. Orrin Adams is the President, J. B. Newcombe, the banker, is the treasurer; H. M. Munsell is the vice-president, L. S. Mott is the secretary and Ewing & Southard are the attorneys.

The Electrical Accumulator Company, of 44 Broadway, are very busy meeting the demand for their storage cells, for light and power. Reports from Philadelphia and Sacramento state that the storage cars there are working very satisfactorily. The company have lately received an award from the Buffalo International Fair Association's first annual exhibition held last Fall at Buffalo, and the diploma is now at their offices. They propose winning some more awards with their new cell just brought out, called the 1889 type. It is an admirable piece of work in this field. While maintaining the best features of the old cell, great improvements have been made. The plates rest upon two separable, non-conducting blocks of hard rubber, as a side support, by means of which they can be taken out very easily and conveniently. There is also a novelty in the shape of a hard rubber piece shaped like a hair pin and called a "hair-pin separator." Four of these are put over every alternate plate, separating them to such an extent as to prevent any trouble from short circuiting, buckling, etc., yet allowing of great compactness, so that the cell presents the appearance of a solid mass, and it can be handled very readily. The side supports, which allow of free expansion and contraction, hold the plates about an inch or so above the floor of the jar, and thus keep them from any possibility of contact at the bottom. The yacht "Tillie," owned by Commodore W. H. Starbuck, of the Knickerbocker Yacht Club, has just been equipped with 54 cells for lighting.

More Electric Street Railways.—During the last week a large number of street railways have decided to abandon the use of horses, and have given orders to the electric supply companies for electric railway equipments. There seems to have been almost an epidemic among the street railway companies in this direction, and at the close of this summer it will undoubtedly be seen that a very large percentage of the street railways in this country will be in operation by electricity. Among the street railways are included some from almost every part of the country. A list from the Sprague Electric Railway & Motor Company of the railways which closed contracts with that company during the past week includes the Long Island City & Newtown Electric Railroad, Long Island City, N. Y.; the Laredo Street Railway, Laredo, Texas; the Collamer Line, East Cleveland, O.; Key City Electric Railway, Dubuque, Ia.; the Union Electric Railway, Sterling, Ill. The Collamer Line at East Cleveland, I understand, is controlled by the East Cleveland Street Railway Company, which is now operating 16 street cars on the Sprague electric system, and this contract for the Collamer line indicates in the most conclusive manner possible the satisfaction which the Sprague cars have been giving on the East Cleveland line, both to the directors of the road and to the general public. All these street railways have ordered the Sprague improved motors which have been illustrated in your columns, and which have recently been installed upon the Atlantic City Electric Railway, N. J. The regular Sprague overhead system of wiring will be used, and all the latest improvements in use upon any of the Sprague roads.

The Brooklyn Electric Light and Power Company, 343 Kent avenue, Brooklyn, have a Loomis incandescent light system in use. The president and general manager is Mr. N. L. Cocheu, the vice-president is Franklin Coit, and the secretary and treasurer is Mr. Black, the New York importer. The directors are C. A. Smythe, R. G. Phelps, G. S. Seeley, S. Burroughs, L. R. Stegman and Theodore Dow, all well-known Brooklynites, with plenty of money. The plant includes 5 dynamos, two being of 500 lamps of 16 c. p. and 2 of 125, 16 c. p. The company have met with many difficulties in the way of obtaining permission to build their circuits, and it is said that while they have made as many as 50 applications for power to run their wires through the streets, they are still denied it. Mr. Cocheu reports, for example, that about the beginning of April he applied for a permit to put up circuit poles to the Board of City Works, but was told that he did not need any. He then put up two poles on the Havemeyer sugar refinery property, whereupon he was notified by the Board to take them down as they were an obstruction, although another company had been allowed to make a liberal provision of poles all along Kent avenue, so that each householder could sit in the shade of his own pole and cross-arms. Although these poles were on private property, the company had to go before Judge Curran and get an injunction restraining the Board of City Works from taking them down. Since then it has had to take proceedings to have the injunction made permanent. I could give more of the details of this incident, but perhaps this will serve to show what some of the difficulties of operation are. The company is already at work supplying current to hotels, business and private houses. The company have a large station, 25 by 100 feet, five stories and basement in height, containing the plant mentioned above, and including, by the way, a temporary plant of a Ball 10 arc machine. Frisbie clutches are used on the counter shaft. Mr. William Ainsworth is the electrician of the company. It is the intention to put up further stations but the company are still awaiting a franchise from the Board of Aldermen, when they propose to lay conduits. These conduits, I may mention, consist of layers of wood fitted together, some short and some long, something like the alternate rungs of a ladder, so that the openings are presented on each side. This wood is treated with paraffine, and after the wires are laid the conduit is boxed up with more paraffined wood.

The Economy Waste Oil Filter Company, 322 Pearl street, N. Y., are meeting with excellent success in sales of their filters, and your representative has been in a number of stations where the filter was in use. In every case they were recommended in the very highest terms, and they had paid for themselves several times over in the saving of oil. They are simple to operate, as the worst kind of refuse that commingles with oil after being used can be abstracted or separated from the oil, which is returned even better than the best refined. The filters come in two sizes, the smallest will hold 12 gallons, and the largest one barrel, and will filter from 5 to 20 gallons in twenty-four hours. They are an ornament to any plant, as they are handsomely got up. To filter the oil, all you do is to throw the refuse oil in a compartment in the top of the filter containing cotton which retains all the refuse in the oil; below this is a brass sieve which retains all sediment, and still beneath are two separate sections of red flannel to filter the oil and to receive all possible grit or metallic substance that may be retained after passing the filters above. Passing into a large receiver, the oil, being the lightest, naturally will remain on top. If any water has been filtered with the oil, the oil overflows into a receiver in the bottom and can be drawn off from the front of the filter; a faucet on the right side allows you to draw off the water. If by any inattention water overflows with the oil into the bottom receiver, it will indicate in a glass tube on the front of the filter, and can be drawn out by a faucet at the bottom. The small size will filter 100 gallons before you need to renew the cotton, which costs but a few cents, and the large size 300 gallons. Mr. John I. Beggs, of the Edison Illuminating Company, 432 Fifth avenue, New York, has

two in use, and speaks in the highest terms of them, and recommends them to all electric light people. The Julien Electric Traction Company, 120 Broadway, say that they have filtered refuse oil from dynamos, countershafts, engines, etc., and it was impossible for any except an expert to detect the difference between the filtered oil and that taken from a new barrel. The Excelsior Power Company, 35 Gold street, N. Y., using large quantities of oil, as they furnish 500 h. p. daily, speak in praise of this filter.

Continental Dynamo Company.—I happened to meet Mr. Peter Claus, general manager of the Continental Dynamo Company, of 42 Exchange Place, one day last week, and was pleased to hear from him of the success with which his specialties are meeting. Mr. Claus, himself a good American, although he has been in this country only a little over seventeen months, did not speak a word of English when he arrived. His experience as an electrician and an engineer goes back to his boyhood days, and he left a lucrative position as superintendent of the Lahmeyer Dynamo Company in Berlin to come to America. After being employed in dynamo building in the largest works in this country, he branched out for himself, introducing the electric light in the Hotel Belvidere, New York, and other places in Philadelphia and the East. Last Fall, in connection with some of our leading German-American bankers, among whom was Mr. C. Schumacher, he organized the Continental Dynamo Company, and since that time he has organized agencies in the East and the West, as announced in your columns. Among the latest installations of the Continental Dynamo Company are a plant for F. S. Meyer & Co., of Maiden Lane, driven by Ball engine, and furnishing current for 150 16 c. p. lamps, and a 75-light dynamo for the Bank of the State of New York; a 100-light testing machine for the Blackstrom laboratory, 12 Jacob street, New York, whose proprietor is making incandescent lamps for the trade, and a 50-light machine for the Hartford Dynamic Company, in whose excellent show rooms on the main floor of 74 and 76 Cortlandt street it can now be seen. Two 50 light dynamos have been sent to Spaulding & Buck, 620 Atlantic avenue, Boston, the agents, to fill orders.

In Philadelphia, the old concern, the Pinkham Electric Company, 27 South Eleventh street, have been appointed agents. Messrs. Hanson, Van Winkle & Co., 92 Liberty street, have secured the sole control of their dynamos for depositing and for electrolytic purposes. I understand, too, that the Continenal Company have placed a large order with E. E. Garvin & Co., Laight and Canal streets, to fit out their new factory in Newark, where they ntend to move as early as possible, and where they will have facilities for turning out dynamos in any quantity. W. T. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 8, Cook Building, cor. Franklin and Congress Sts.
BOSTON, May 18, 1889.

Weymouth Light and Power Company.—The organization of the Weymouth, Mass., Light and Power Company, capital $50,000, is now completed. The construction work will be pushed forward at once.

Mr. Chas. L. Ireson reports the spring trade in link and other electric light belting opening finely. As New England is going to be unusually active in the matter of new installations, Mr. Ireson has already secured some handsome orders and is correspondingly busy.

Quincy, Mass.—Pending the completion of the electric road between Quincy and Neponset, the street cars will run between the above-named places on schedule time. This slow method of transportation will, by contrast, enhance the appreciation of the new electric road, and whet a healthful appetite for more.

Putnam, Conn.—The gas and electric light companies of Putnam, Conn., have consolidated, the capital for the combined plant being $40,000. This is only another case of the amalgamation of the gas and electric companies, which I have noted from time to time, and which seems to be happily contagious in New England.

New Manager for the West End Company.—The West End Railway Company have accepted with regret the resignation of Mr. D. F. Longstreet as director and general manager of that company. Mr. Longstreet's successor is Mr. Frank H. Monks, well known in connection with previous railroad enterprises, and thoroughly posted in the duties of his new office, which will begin at once.

The New York Insulated Wire Company.—I have just received a pleasant call from Mr. G. F. Bolton, of this city, who will henceforth represent the New York Insulated Wire Company in Boston and vicinity. Any one wishing to know anything about Grimshaw "White Core," insulating tape, or the whereabouts of Mr. Jim Godfrey, will find Mr. Bolton pleased to furnish the information at his office, No. 11 Central street, Boston.

New England Electrical Exchange.—A bill incorporating Messrs. Frank Ridlon, G. W. Davenport, H. B. Cram, P. H. Alexander and associates as the New England Electrical Exchange, having passed the Senate, will soon pass the House and enable the Exchange to hold $100,000 in real and personal estate. This is putting the affairs of the New England Electrical Exchange into practical working shape.

Mr. David Dunn.—The light of "Davy" Dunn, whom every electrical man in Boston knows, has lately been covered by the bushel of exile, which is one way of saying that he has been superintendent of the Petersburg (Va.) Electric Light Company, where he presided over the operation of 200 arc and 500 incandescent lamps of the Thomson-Houston system. Mr. Dunn is now back in Boston, where he is temporarily being detained by the illness of his wife, which it is hoped will be of short duration.

Defeat of the Elevated Road Bill.—The defeat of this bill puts the matter off another year at least. In the meantime the West End Railway Company are acting squarely in their effort to bring the overhead system into the heart of the city. They agree to furnish an indemnity bond of $50,000 to cover any possible damage to the city, will use a metallic circuit, if found necessary, and should it become necessary at any time for firemen to cut their wires the company will repair same at their own expense.

Mr. J. J. Renehan, 16 Vine street, New Britain, Conn., has put an excellent mast arm, bearing his name, on the market. This arm is built of wrought iron pipe and bracings, and is operated by means of an endless wire rope. One run passes through the pipe out over the pulleys, the other run being directly below. To this the lamp is fastened. It is speedily operated, four seconds being all that is required to transfer the lamp. The sleet cannot nterrupt its operation, nor does this arm interfere with traffic.

Messrs. Pettingell & Andrews have closed negotiations with the Electrical Supply Company, of Ansonia, Conn., for the exclusive agency of the celebrated "P. & B." line wire and the "P. & B." electric compound. They have also just assumed control of a factory for the production of cross-arms, pins and brackets, in order to handle their increasing demand for this line of goods. The "P. & B." electric compound is growing in favor as an insulating paint, and is used for waterproofing anything from armature coils to poles and cross-arms. Messrs. Pettingell & Andrews have to "hustle" to supply their immense spring trade.

The Bernstein Electric Company.—The only way to see Mr. H. B. Cram, treasurer of the Bernstein Electric Company, nowadays, is to catch him at his office, and I always feel guilty when I drop in there, because he is certainly one of the busiest men in town. However, in a minute's conversation which I managed to secure the other day, I learned that the company is under enormous pressure to meet the demands on its output of lamps by a vigorous spring trade—usually dull—that even now is far in excess of the ordinary fall and winter business. This company is certainly rapidly coming to the front and is evidently in the hands of able men, who are pushing the business for all there is in it.

Electricity against Steam.—The new Thomson-Houston road which will run from Revere Beach to Winthrop Junction will afford an opportunity to test the speed of electric cars in an interesting and exciting way. For some distance this road will run near and parallel to the narrow gauge road and the prospect for lively races during the summer season is certainly not feared by the electrical people. Such a test of speed between electricity and steam will be more conclusive to the public mind than any possible effect produced by a priori speculation or the filmy dynamics of persuasion. Let the races go on, and may the better road win in the time of its trains and the estimation of its passengers.

Current Quotations.—R. D. Wilson & Co., dealers in electric securities, stocks and bonds, 113 Devonshire street, quote the following prices on electric stocks closing May 15:

	Bid.	Asked.
Thomson-Houston Elec. Co.	86½	87½
" " International, com.	125	135
" " " pref'd.	101	102½
" " Carbon "	.....	125
" " Series C.	18½	19
Thomson Electric Welding Co.	350	375
Westinghouse Elec. Co.	57½	58
Bell Telephone	236½	237
New England Telephone	.....	48
Erie Telephone	33	34
Mexican	.....	70
Edison Phonographic Toy Mfg. Co.	9¾	10

The Portelectric System in Boston.—In your issue of May 4 was presented a full description of the Portelectric system for the electric transmission of mail and other matter at enormously high rates of speed. On May 14, in response to the invitation of the inventor, Mr. J. T. Williams, about one hundred representatives of the press, electrical, scientific and business men, bankers, etc., gathered at the historic Old South Church, Boston, to inspect the working model there displayed and listen to explanations of same by Mr. Williams and Professor Dolbear. In these remarks and the discussion which followed, a number of important points were brought out, not already alluded to. In the actual line which it is proposed to construct between New York and Boston, five dynamo stations will be used, each station working about twenty-five miles of mains on each side of it. Calculations have already been made to commence with a speed of two miles per minute, and the actual time of mail matter between Boston and New York will be not more than two hours, probably less. It seems certain from all the data at present obtainable that the friction of ball bearings on the car wheels, and that of the air, will by no means be sufficient to render this speed impracticable with a potential of 220 or 250 volts. Mr. Williams spent the afternoon of the press reception in answering questions from men of all classes, business men, newspaper men and electrical experts. I noticed him at one time under the cross-fire of two very well known electrical representatives, one of the Thomson-Houston Company, the other of the Sprague Electric Railway and Motor Company, who had dropped in informally with myself for personal information. In the opinion of most of the thoughtful electrical and mechanical people whom I have heard express an opinion, the only elements required now for successful performance are a good, practically working section, and the perfection of one or two minor details. Communication by ordinary mail with New York in two hours, with the mail "closing" in each city every five minutes, if a fact of the future, will certainly have a most potent and appreciated effect on business correspondence, and open up the next natural question, that of the transportation of human beings at a rate of two miles a minute or more. The Boston daily papers have devoted several columns each to this matter, and the interest felt, though perhaps somewhat speculative in the more conservative, is genuine and hopeful in all.

F. R. C.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
41 Lakeside Building, Chicago, May 18, 1889.

Mr. Fred De Land, of the Sperry Electric Light Company, has gone to Missouri upon a business trip.

The St. Paul City Railway Company, of St. Paul, Minn., will put in a plant of 150 incandescent lamps.

Electric Lights in Montana.—The town of Livingston, Mont., has installed a plant of 20 arcs and 600 incandescent lamps of the Thomson-Houston system.

Pond Engineering Company.—As an evidence of the interest taken in electrical subjects, the Pond Engineering Company, of St. Louis, report a great number of sales of books of a practical nature to electricians and others.

The Chicago Arc Light and Power Company has increased its plant by an addition of 1,000 incandescent lamps of the Thomson-Houston pattern. Among the other plants put into Chicago by this company is one for the works of N. K. Fairbanks & Co., of 750 incandescent lamps.

Telephone Quotations.—Col. S. G. Lynch, broker, 146 La Salle street, furnishes quotations upon telephone stocks as follows:

Bell of Mo.	$150@	$153	Iowa Union	$22@	$25
Central Union	50@	51	Michigan	81@	82
Chicago	300@	305	Mo. & Kansas	65@	67
Colorado	39@	40	Rocky Mountain Bell	40@	41
Cumberland	67@	69	Wisconsin	116@	117
Great Southern	31@	33			

Carrollton, Mo.—This little burg is having quite a boom, several new buildings going up, and new factories locating here. Mr. J. W. Lacy is the manager of the Missouri & Kansas telegraph exchange. Office and circuits are in good condition, and new subscribers gradually added. Mr. Lacy is also the owner of the Carrollton Electric Light Works, and since purchasing the plant has placed it on a paying basis. It is operating two twenty arc light low tension Sperry dynamos, and has been carrying forty-three arc lights on same, but is now replacing six arc lights with about 70 Sawyer-Man incandescent lamps, operated from the arc circuit, and will shortly add an improved high tension Sperry dynamo, with twenty improved Sperry lamps, for the commercial circuit. He has a twenty year franchise for electric light, railway, etc., and expects shortly to have an electric railway in operation.

Electrical Development on the Pacific.—The Electrical Improvement Company, of San Francisco, have placed, and are now operating, a plant of 100 lights capacity along the water front. Their intention is to get a franchise for overhead wires to do commercial lighting throughout the city. As yet they have been unable to have their application for such franchises acted on by the Board of Supervisors. The American System is used in this enterprise. San Francisco contains but one other central station, that of the California Electric Light Company, using the Brush system. Their old Brush works gradually becoming over-loaded, they were compelled to rent a portion of the Mechanics' Pavillion, where for over six months they have been operating 120 lights. They have now completed a large and commodious structure on Townsend street, between Second and Third streets. Their boiler house is 80 by 120 feet, and built of brick, iron roofed, containing a battery of thirty Keystone horizonal tubular boilers of 100 h. p. each. At the rear of the boiler house is a sturdy stack 150 feet high, with an inside diameter of 7 feet. The engine room is 80 by 155 feet, and is directly in front of the boilers. There are four compound condensing engines of 750 h. p. each. The works are located near the Bay, which facilitates the use of the salt water for condensing. This building is three stories in height, the second floor accommodating 56 Brush machines. In the middle of the ground room is an immense switch-board. The top floor is used as a store room, and it is intended to move the workshop to that portion of the building. A shaft about 40 feet long and 10 feet wide runs through the middle of the building from the switch-board, carrying the mains to a "horse" on top of the building, where they are distributed in all directions by means of a number of 100-foot poles. The floors are 5 inches thick, all separate from the walls, being supported by iron pillars and heavy stringers between them. Mr. Wm. M. Thomas, of the Mather Electric Company, is installing a plant in the California Hotel and Theatre. The theatre is to have 1,500 lights, and will be in operation on the 13th of May. Two 80 h. p. Payne automatic engines have been set, which will run four dynamos. The hotel will have about the same number of lights as the theatre.

W. A. N.

THE TELEGRAPH.

The American Rapid Company asks for an injunction against the Board of Electrical Control in this city to stop wire cutting. The court is asked to declare the subway laws unconstitutional and void.

The Pacific Writing Telegraph Company has undergone a re-incorporation. It has a capital stock of $2,500,000. The directors are: M. L. Hadley, H. W. Brown, J. F. Murray, E. L. Campbell, L. W. Storrer, J. B. McChensey and T. H. Barry.

St. Louis Bucket Shops.—A special dispatch from St. Louis of May 16 says: "The Merchants' Exchange of this city has begun a war on the bucket shops. At a meeting of the Board of Directors yesterday a resolution was adopted cutting them off from St. Louis quotations. It was also decided to formally request the Chicago Board of Trade to refuse them quotations.

THE TELEPHONE.

Monett, Mo.—C. A. Raupp proposes to run a telephone line from Monett to Pierce City.

After the Telephone People.—Mayor Grant is now anxious to have the District Attorney prosecute the Metropolitan telephone people for alleged laches in regard to overhead wire work.

The Telephone in Diving Operations.—The telephone was recently used with success at Dartmouth, N. S., by some divers who were provided with the "Unique" telephone, a French instrument. The trials were made from a raft and in 30 feet of water.

A New Graphophone Syndicate.—A special dispatch from Philadelphia of May 16, says: A syndicate of Philadelphia capitalists, headed by Thomas Cochran, has purchased the graphophone rights for the world outside of the United States and Canada. The price paid was $500,000.

Infringement at Hutchinson, Kan.—An injunction has been granted the American Bell Telephone Company against the Hutchinson, Kan., Water, Light and Telephone Company, which has been using infringements of the Bell telephone patents. The operation of the decree, which includes damages, has been stayed until June 10.

The Government Suit.—Ex-Solicitor-General Jenks has accepted the charge of the government case against the Bell Telephone Company, and the motion will be made at Boston to appoint an examiner. The case is to be pushed against the Bell people with as much energy, it is alleged, as though there had been no change of administration.

Asbury Park, N. J.—The Shaver Telephone Company, of Monmouth County, has been organized at Asbury Park with the following officers: President, D. R. Kelly; vice-president, Charles Howell; treasurer, William Ehrlich; secretary, A. L. Thomas; directors, D. R. Kelly, D. E. Lancaster, Charles Howell and William Ehrlich. The central office of the company will be at Asbury Park. The system is an acoustic one. The position of superintendent has been tendered to H. O. Hudson, who was at one time the local manager of the New York and New Jersey Telephone Company.

Long Distance Telephony.—A special dispatch from Milwaukee, of May 14, says: "Henry C. Payne, chairman of the Republican State Central Committee, has been offered the position of western manager at Chicago by the Bell Telephone Company, the salary to be $12,000 a year. The company is planning a long-distance system connecting Chicago, St. Louis, Cincinnati, Indianapolis, Omaha, Kansas City, St. Paul, Minneapolis and Milwaukee. The centre of the system will be at Chicago, and through that station New York, Philadelphia, Boston and Washington will be connected with all the other points. If Mr. Payne accepts he will be made president of all the companies included in the consolidation that would become necessary."

THE ELECTRIC LIGHT.

Russia will light its navy throughout by electricity.

Abilene, Kan., is talking about a city electric light plant.

Alexandria, Va., is to have a Schuyler city plant for $14,000.

Florence, Ala.—The Florence Electric Light Company will enlarge their plant.

Portchester, N. Y.—An electric light plant is to be established by the Citizens' Gas Company.

Knoxville, Tenn.—The University of Tennessee will put in an incandescent plant of 150 lights.

The Sun Electric Light Company, of Chicago, have increased their capital stock to $250,000.

Newcastle, Pa., will receive bids on street electric lighting till May 25. Mr. J. H. Miller is the city clerk.

Holley, N. Y.—The Western Electric Company have sold a plant to the Holley Electric Light Company.

Toledo, O.—The Union Electric Company, of Toledo, O., has been incorporated with a capital stock of $100,000.

Jackson, Mich., proposes to own a city electric light plant, and will have its charter amended for that purpose.

Laredo, Tex.—The Laredo Electric Light and Power Company have increased their boiler capacity from 200 to 400 h. p.

Goldsboro, N. C.—Power for the new electric light plant of O. H. Foster will be furnished by the Enterprise Lumber Company.

Bath, N. Y.—The village has made a contract with the New Jersey Electric Light Company for 40 street lights at $500 a year.

Athens, Tenn.—The Manhattan Electric Light Company of New York have secured the electric light franchise recently asked for.

Albion, N. Y., is considering favorably a proposition for arc and incandescent lighting from the Mutual Company, of Brooklyn.

Mammoth Spring, Ark.—The Mammoth Spring Water, Light and Motor Company has an electric light plant and an electric road in contemplation.

Liberty, Va.—W. T. Fitzpatrick and others have been appointed a committee to investigate electric lighting with a view to having a plant erected for or by the city.

Lexington, Mo., will receive bids on street lighting by gas or electricity, to be in operation by October. Mr. A. P. Johnson, City Register, can furnish particulars.

Stern & Silverman, Edison agents, of Pittsburgh, Pa., are erecting a 225-light plant for the Standard Oil Company's large "Eclipse" works at Franklin, Pa.

The Evansville, Ind., Gas and Electric Light Company have found it necessary to order additional Brush arc lamps to meet the demand for lighting in their city.

Battle Creek, Mich.—The amendments made in Battle Creek's charter allow the city to erect an electric light plant for commercial purposes, as well as to light the city.

Amherst, Mass.—The Amherst Electric Light Company has been incorporated with a capital stock of $15,000. Mr. F. E. Paige is president, and Mr. G. P. Warner is the treasurer.

St. Joseph, Mo.—Work has begun on the city plant of the Excelsior system. The city adopts the overhead method of wiring, stringing the wires as much as possible along the alleys.

Peirce City, Mo.—Mr. J. Guinney and his associates have been granted a franchise for street lighting and have a contract from the city for 36 lamps of 25 c. p. at an annual rental of $18 per year.

St. Paul, Minn.—The Thomson-Houston Electric Light and Power Company has been formed at St. Paul by H. W. Turner, F. B. Fleetham, C. A. Daigh and others, with a capital stock of $500,000.

Batavia, N. Y.—The Consumers' Electric Light Company has a contract for three years at $4,500, $3,700 and $3,500, respectively; 45 lights to burn till midnight at $54.81; and 15 lights all night at $84.45.

The Illinois Anglo-American Storage Battery Company has been formed at Chicago by J. B. Long, A. C. Bales, and L. Shissler, with a capital stock of $500,000, to manufacture batteries, lighting apparatus, etc.

The Toronto, O., Electric Light and Power Company have signed a contract with Messrs. Stern & Silverman, Edison agents, Pittsburgh, Pa., for the furnishing and erection of a 600 Edison central station electric light plant.

Philadelphia.—The Philadelphia representative of the Brush Electric Company, Mr. Edward W. Tisdall, has secured another order for a 65-light Brush arc dynamo with dial and lamps. This outfit will be used for central station lighting.

The Louisville, Ky., Bagging Manufacturing Company has recently decided to introduce electric light into its factory, and have placed an order with the Brush Electric Company of Cleveland, for an incandescent plant complete.

Brush Apparatus in Demand.—A representative of the Brush Electric Company has just returned to Cleveland bringing with him an order for a 600-light incandescence plant to be installed in the works of the Louisville, Ky., Woolen Mills.

Wheeling, W. Va.—The Reymann Brewing Company, of Wheeling, W. Va., are lighting all their vaults, brew and malt houses with a 225 Edison light plant. The contract for the installation was made by Stern & Silverman, of Pittsburgh.

Piedmont, W. Va.—Stern & Silverman, Pittsburgh, Pa., agents for the Edison Company, have been awarded the contract for the furnishing and erection of a 600-light central station plant and 20 arcs, including 70 h. p. steam plant. The Piedmont Company have been awarded the contract for the furnishing to the city of 15 arc lights.

The Tennessee Electric Light Company, of Chattanooga, has been formed by G. B. Pennock, A. J. Wisdom, A. M. Johnson and others, with a capital stock of $100,000. It is reported that Memphis parties have bought rights to use the Pennock battery, etc., from the company for $10,000. It would be interesting to know just what they get for their money.

A Bureau for Philadelphia.—The committee on municipal government of Philadelphia has recommended an ordinance creating a bureau of lighting in the department of public works in that city. The ordinance provides that the new bureau shall consist of a chief at $1,800 salary, a clerk at $1,000, five district superintendents at $900, and lamp lighters, not to exceed one to each sixty lamps, at $500.

The Edison General Electric Company, at a meeting held last week, elected as vice-president Mr. J. Hobart Herrick, whose choice for the position was foreshadowed in these columns last week. Mr. J. C. Henderson was appointed chief constructing engineer, and Prof. W. D. Marks, of Philadelphia, engineer in chief. Mr. Henderson is well known in connection with his early work with the Edison system on the Pacific Slope.

Jersey City, N. J.—It is said that the talked of scheme for another plant in Jersey City will be carried out, and that parties backed by plenty of capital are ready to enter the field there, where the opening is so good. The new company point to the financial success of the old one, and say that there is plenty of room for them, owing to the fact that the plant now running is not of sufficient capacity to take care of all the business offering or that can be worked up.

Council Grove, Kan.—On April 1, the City Council reduced the electric light rental to the following schedule of prices: Arc lights, $6.25 per month, or $75 per year; 65 candle-power incandescent lights, $3.50 per month, or $42 per year; 32 candle-power incandescent light, $1.75 per month, or $21 per year. The city will be charged the same for lights as consumers. Last year the income from the plant about paid for operating expenses and repairs, leaving the city to make up the interest.

Fitchburg, Mass.—The Hill Clutch Works, through their Eastern office, 18 Cortlandt street, New York, inform us that their designs for the building and complete equipment with everything in the line of power transmission machinery and "Hill" friction clutches, of the new electric light station of the Fitchburg Gas Company at Fitchburg, Mass., have been accepted by the Gas Company. Work on the building is now in progress, and it is expected that the station will be in running order in the course of sixty days.

Franklin, Mass.—The Franklin Union Electric Light Company has a plant of two 30-light Thomson-Houston arc machines and one 500-light alternating of the same make. This month they started an incandescent street circuit, and they are now going to put in another 500-light alternator. They are doing a good deal of house lighting and "pushing things for all they are worth." The steam plant consists of two 100 h. p. boilers, one 50 h. p. Armington & Sims engine and one McIntosh & Seymour engine of 100 h. p. Mr. F. W. Crocker is the superintendent and electrician.

APPLICATIONS OF POWER.

Modesto, Cal., may have a street railway on the Euphrat electric system.

DeLand, Fla.—Mr. C. A. Webber wants information as to electric power for railways.

Wichita, Kan.—Vestibule car service has now been established on the Wichita electric road.

Yankton, Dak.—Mr. R. F. Pettigrew has obtained a franchise for an electric road 1½ miles long.

Denison, Tex.—A new street railway company is asking for a franchise and may use electricity.

Bay City, Mich.—Work has begun on an electric road at Bay City, the Sprague system being used.

Staunton, Va.—The Staunton Improvement Company will build an electric road three miles long.

Spartanburg, S. C.—Mr. A. H. Leftwich, of Greensboro, N. C., and others have obtained a franchise for an electric road from Spartanburg to Clifton.

Sprague Roads.—The Sprague Company had in operation or under construction on April 26 no fewer than 44 roads, with 200¼ miles of track and 361 cars.

Portland, Ore.—The Transcontinental Street Railway Company and the Multnomah Company both propose to adopt electricity, following the example of the Willamette Bridge Railway Company.

New York City.—A bill was passed just before the adjournment of the New York Legislature enabling New York street railways to substitute cable or electric motor for animal power, on the approval of the Railroad Commissioners.

Topeka, Kan.—A local paper says: "The electric trains ran as smoothly yesterday during the heaviest gales of wind as on any other day. The propelling power is so strong that there was no perceptible difference in going towards or with the wind. Trains ran as usual and no time was lost. The people of Oakland are delighted with the electric transit service, and do not tire in speaking of its good quality."

PERSONALS.

Mr. V. H. Emerson, of Flemington, N. J., took a phonograph to the roof of his house during a recent thunderstorm, and bottled up some of the thunder with it.

Mr. W. H. Meadowcroft contributes to the *Youth's Companion* an excellent illustrated article in simple language entitled, "Volts, Ampères and Ohms," explaining the electrical units and their uses.

Rufus B. Bullock, of Atlanta, Ga., recently appointed by President Harrison one of the Government Directors of the Union Pacific Railway, is an old-time telegraph operator. He was Governor of Georgia from 1869 to 1872.

Mr. H. M. Byllesby has sailed for Europe with his wife for rest and recreation, after a very arduous season of work, consequent on the rapid growth of the business of the Westinghouse Electric Company under his management.

Mr. G. W. Hebard, president of the United States Company, describes the electric light situation as most hopeful and encouraging. His company is overwhelmed with business, while the new contracts offering are on a larger scale than ever.

Mr. J. O. Stockwell, manager of the telephone service at Emporia, Burlington and Ottawa, Kan., will, it is stated, enter the experimental department of the American Bell Telephone Company. He has a new method of overcoming troublesome induction.

Mr. J. F. Butterworth, representing *Industries*, left by the "City of Paris" last week, after a voyage around the world. Mr. Butterworth stayed long enough in New York to make a number of friends and acquaintances, many of whom look forward to seeing him again in Europe this summer.

Mr. Herbert L. Webb, who has recently arrived in America with excellent introductions, is a nephew of Mr. F. H. Webb, the well-known secretary of the English Institution of Electrical Engineers. He is a young electrican who has had great experience in submarine and underground work, as well as in cable construction; and he proposes to devote his attention and energies to subway work in this country.

Mr. Carl Hering sails on May 25 on "La Champagne" for France, going direct to Paris from Havre. He is on the United States Commission to the Paris International Exposition, having been appointed to do some expert work for the government in the Electrical Department. He is also one of the five delegates from the Franklin Institute to represent its interests at the Exposition and to make reports on the electrical exhibits.

MISCELLANEOUS NOTES.

The Franklin Electric Company has been incorporated at Chicago, by E. E. Flora, P. R. Hoy and E. J. Tooze, with a capital stock of $5,000 to manufacture electrical supplies and apparatus.

Hartford, Conn.—The mayor of the city thinks it wisest to go slow about putting the wires underground, and says: "No unnecessary impediment should be placed by the council to retard the introduction or extension of any branch of electric service."

New Orleans, La.—The Southern Electrical Manufacturing and Supply Company, Limited, has been formed at New Orleans by S. Logan, H. R. Giffey, F. A. Pattison, J. H. Sullivan and others, with a capital stock of $50,000 to build electrical apparatus.

Reasons for Gratitude.—One thing to be grateful for—that the subway explosion in Union Square did not take place during the Centennial. One thing to be hopeful for—that our pavements will stop heaving before the next Centennial.—*New York Tribune.*

Another Subway Explosion.—An explosion in the New York subways occurred last week, at the corner of Union Square and West Fifteenth street, where the thoroughfare was rather badly broken up. Fortunately the explosion occurred at night, about 10:30 when there were very few people in the vicinity. The leakage of gas is again said to be the cause.

BUSINESS NOTICES.

Chas. A. Schieren & Co., New York, are the patentees and sole manufacturers of the perforated electric leather belting. The perforations obviate air cushions; hence belts run slack with less strain on bearings, and without slip.

The Brown & Sharpe Manufacturing Company, of Providence, R. I., have prepared for distribution an admirable little folder on the subject of spur gears. It fits the pocket, and is full of interesting points and data as to the manner of arriving at pitch diameter, number of teeth, distance between centres of two gears, etc.

Patterson, Jordan & Gottfried, 146-150 Centre street, carry a complete stock of brass and iron machine and wood screws, cap and set screws, all kinds of bolts, taps, files, twist drills, brass and rubber tubing, brush copper, rod and sheet copper, brass rod, sheet German silver, sheet brass, machinery, tools, hardware, etc. Electric motor supplies.

The California Electrical Works, of San Francisco, John I. Sabin, president, and Andrew White, vice-president and manager, have issued a new and tasteful catalogue, with the name in lightning flashes on a creamy golden background. The catalogue has a prosperous, auriferous look about it, and its 120 pages are full of electrical novelties and apparatus of saleable nature and of all the well known makes. The works are agents for Okonite, the Gamewell Fire Alarm System, Thomson-Houston apparatus, Warner's Gauges, the Leclanché Battery Company, and many other houses and specialties.

Mr. George F. Page, president of the Page Belting Company, Concord, N. H., has just been granted a patent on a new and improved link belt, constructed upon new principles. It obviates the difficulty experienced in the running of the old style link belts, as it gives complete contact upon the pulleys in every direction and will transmit a much larger amount of power than link belts constructed upon methods heretofore in use. This new department of the company's business is now being fitted up with facilities for the manufacture of these improved link belts, thus adding to their large business of lace leather and leather belting.

Westinghouse Engines.—The Westinghouse Machine Company has works at Pittsburgh covering two and a half large squares and employing a capital of over $700,000. It is now building "Junior Westinghouse" engines in six sizes, from 5 to 50 h. p.; Standard automatics in 13 sizes, from 5 to 250 h. p., and automatic compounds, condensing and non-condensing, in 16 sizes, from 5 to 500 h. p., inclusive. It is interesting to note that the company pays its erectors $18 per week, while similar workmen in England get only $6, while "shop labor" is paid for at the rate of $12, as compared with $3.60 in England. Yet the engines are marketed in England and all over Europe in direct competition with the product of the largest English, French and German builders.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENTS ISSUED MAY 14, 1889.

403,092. Connector for Electric Railways; Leo Daft, of Plainfield, N. J. Application filed June 18, 1888. In a cross-connector for electric circuits, the combination, with the jaws connected to the terminals of the circuit, of hinged arms connected to the jaws and springs arranged to maintain the arms in alignment with the jaws.

403,104. Electrical Signaling Apparatus; Adin A. Hatch, of Kansas City, Mo., Assignor to Benjamin F. Jones, Edward L. Martin, and Alfred W. Jones, all of same place. Application filed March 22, 1889. In an apparatus intermediate between a main electrical conductor and a separate signaling or other instrument the combination, with a plate or support having single and manifold keys, representing respectively one electric pulsation or a series of such pulsations with intervals between the single and manifold keys of an armatured escapement lever vibrated by said pulsations and provided with a finger adapted to engage said key-bars and work out the combination represented, said plate having normally a progressive movement proportioned to the character of the pulsations, and the escapement lever having a vibrating finger by which the movements produced by the long pulsations are spaced or equalized.

403,110. Electrically Heated Vacuum-Pan; Gail B. Johnson and Milbank Johnson, of Elgin, Ill. Application filed June 1, 1888. The combination, with a jacketed vacuum-pan, of electric resistance wires within the liquid-containing part of the pan, and also around the lower part of the same.

403,157. Method of Electric Welding and Shaping of Metals; Elihu Thomson, Lynn, Mass. Application filed Oct. 15, 1888. The improvement in electric metal working, consisting in setting up or establishing a counter electromotive force or tendency in those parts of the work which form a shunt to the part to be heated, for the purpose of confining or localizing the heating current at the part to be operated upon.

403,158. Dynamo-Electric Machine; Henry E. Walter, of Schenectady, N. Y. Application filed April 21, 1888. In a dynamo-electric machine, the combination with the armature and main field-magnet of an extra magnet having coils in series with the armature and acting on the armature coils outside of the main field of force.

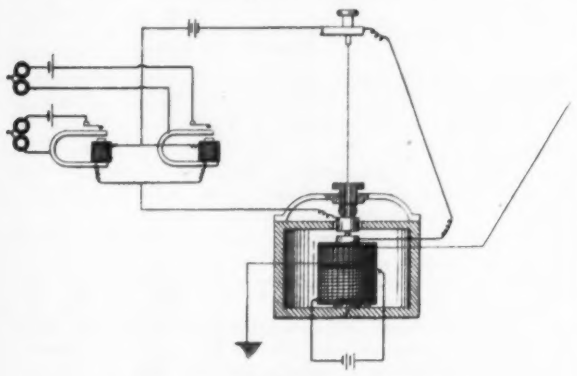
403,177. Time-Switch for Secondary Batteries; Charles E. Buell, of New Haven, Conn. Application filed Nov. 15, 1881. The combination with a charging circuit of secondary batteries and a switch for connecting said circuit to said secondary batteries, of a branch of the charging circuit leading around the switch and a working circuit having connection to the batteries through independent switch mechanism.

403,180. Electrical Float-Signaling Apparatus; John R. DeMier, of Las Cruces, Territory of New Mexico. Application filed Aug. 21, 1888. The invention consists in the combination of an electrical apparatus, an indicator float, electrical switch, a battery, and switch connections with a telegraph line wire, and to this a thermostat may be added for operating an additional electrical switch by means of the said battery, whereby either high water or fire, or both, may be signaled by a danger flag at either side of a bridge, and also signaled over a line wire to the adjacent telegraph stations.

(1) 403,192. Electric Railway; (2) 403,193. Means for Electrical Propulsion of Boats; Rudolph M. Hunter, of Philadelphia, Pa. Applications filed (1) Dec. 13, 1888; (2) Dec. 26, 1888. (1) The essential feature of this system is that the motors, or trains are made to travel over a conductor which is automatically broken at successive points within range of the length of the train, so that the current is brought up from the line through the motor and led back again to the line, whereby all the motors or trains are working in series with each other through a sectional conductor and receiving their electric energy from a common source. (2) A canal, having two portions thereof at different levels and a lock for transferring boats from one level to the other, in combination with a water power motor operated by the difference in level of the water of the canal, an electric generator operated by the water power motor, a line conductor arranged along the canal, or substantially parallel thereto, receiving electric current from said electric generator, an electrically propelled boat, and a collector carried by the boat and making a traveling contact with the line conductor.

403,244. Apparatus for Registering the Consumption of Electric Energy; Lucien Brillié, of Paris, France. Application filed Dec. 29, 1888. Patented in France April 14, 1888. This apparatus relates to the class of watt-hour meters; it is based on the employment of a torsion electro-dynamometer, and serves to measure periodically the angle of torsion of the spring of the electro-dynamometer.

403,250. Method of Reducing and Separating Magnetic Ores; John D. Cheever, of New York, N. Y. Application filed Feb. 20, 1889. The method of treating magnetic ore for the separation of the magnetic from the non-magnetic particles by first heating the ore; second, reducing or disintegrating it while



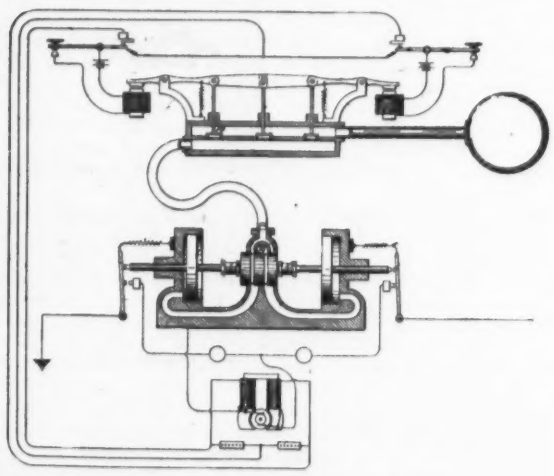
403,258. VIBRATORY TELEGRAPHY.

hot, and, third, separating the magnetic from the non-magnetic particles by bringing both together into and through a magnetic field.

403,253. Galvanic Battery; Charles Colle, of Lille, France, Assignor to Hector Lahousse & Co., of same place. Application filed Oct. 1, 1888. Patented in England, June 18, 1888, and in Belgium, June 8, 1888. In a two-liquid battery with a porous cup, the combination of a solution of bisulphate of mercury and concentrated nitric acid, in suitable proportions, and a zinc plate in one cell, with granular retort carbon and ordinary carbons and nitric acid in the other cells.

403,256. Device for Collecting Metallic Ores; Henry H. Eames, of Baltimore, Md. Application filed May 14, 1888. In a device for collecting metallic ore, the combination of a moving endless bed provided with metallic plates, means for causing an electric current to pass through the said plates, and means for causing a stream of water to flow over the said bed.

403,258. Vibratory Telegraphy; Stephen Dudley Field, of Stockbridge, Mass. Application filed Nov. 21, 1888. This invention relates to improvements in apparatus for the transmission of signals in accordance with what is termed a "system of vibratory multiplex telegraphy" wherein a constant succession of vibratory electric impulses are transmitted over a single main line and received at a distant point by means of an apparatus capable of analyzing the resultant vibrations of the transmitting apparatus and separating them into their component sets for translation by local receiving instruments or sounders at the distant station. The object of the invention is to provide means whereby a single transmitting key in the main line may be so controlled by subsidiary keys in branch or home circuits that its movements may be so timed as to produce on the main line resultant vibrations, which



403,258. VIBRATORY TELEGRAPHY.

at a distant station in turn will produce results which shall correspond to the various keys which may have been closed at the transmitting station. See illustrations of transmitter and receiver.

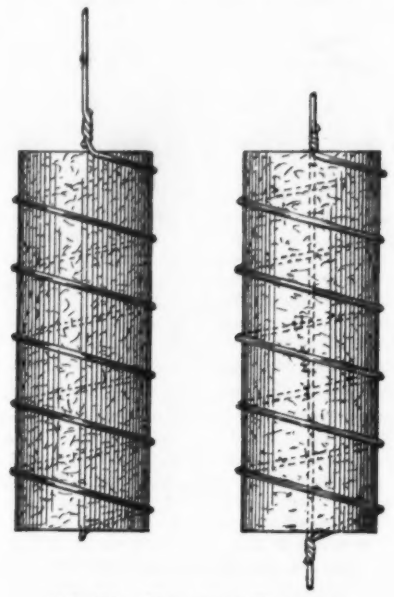
403,261. Insulated Wire; Solomon Heimann, of New York, Assignor of five-twentieths to Frank L. Pommer, of Stapleton, N. Y. Application filed March 27, 1889. An insulated wire composed of an electric wire, a layer of cotton thread on the same, a coating of soluble glass and glycerine, and a layer formed of pulverized pumice-stone and plumbago.

403,262. Covering for Electric Cables; Eben F. Garland, of Lynn, Assignor of one-half to Solomon H. Holbrook, of Salem, Mass. Application filed Feb. 28, 1888. The combination of an electric cable and a metallic pipe inclosing said cable, the pipe being slit longitudinally and its slit edges separated from each other by a waterproof strip of insulating material.

(1) 403,291. Exchange System for Telegraphs; (2) 403,292. Combined Telephony and Telegraphy; James H. Robertson, of Rutherford, N. J. Applications filed (1) Nov. 23, 1886; (2) Jan. 6, 1887. (1) In autographic telegraphy, the combination, with a number of conductors of different resistances extending from the subscribers' instruments to, and terminating in, a central office, of switching means for electrically connecting any two of said conductors and equalizing resistances, whereby the combined resistance of any two conductors that may be connected with each other is made approximately the same. (2) The combination, with an autographic telegraph of a telephone, the secondary circuit of which is arranged in inductive proximity to the receiving electro-magnets of the autographic telegraph.

403,308. System of Electrical Distribution; Edward P. Thompson, of Elizabeth, N. J. Application filed March 18, 1887. An electric converter, means for forming electrical connections with the primary coil of the same, and an electric light socket carried upon the converter in which the terminals of the secondary coil terminate.

(1) 403,311. Measuring Instrument; filed Feb. 28, 1889. **(2) 403,312. Portable Tangent Galvanometer;** filed May 10, 1888; Edward Weston, of Newark, N. J. (1) Consists of combining with any form of index or pointer two scales in proximity to and indicating the extent and movement of the body, the said scales being similarly and uniformly divided, and corresponding divisions on said scales being marked and representing on one scale a unit or number of units, and on the other scale a certain fraction of said unit or number of units. (2) The principal novel features embodied in the instruments consists in the construction and arrangement of the damping chamber for preventing undue oscillations of the magnet needle in the form of the ring magnet and its combination with the index mirror and standard; in the combination of the standard magnet and mirror with the scale



403,451. ELECTRIC BATTERY.

chamber located upon the standard, and in the various other instrumentalities and combinations entering into the construction of the apparatus. See illustration.

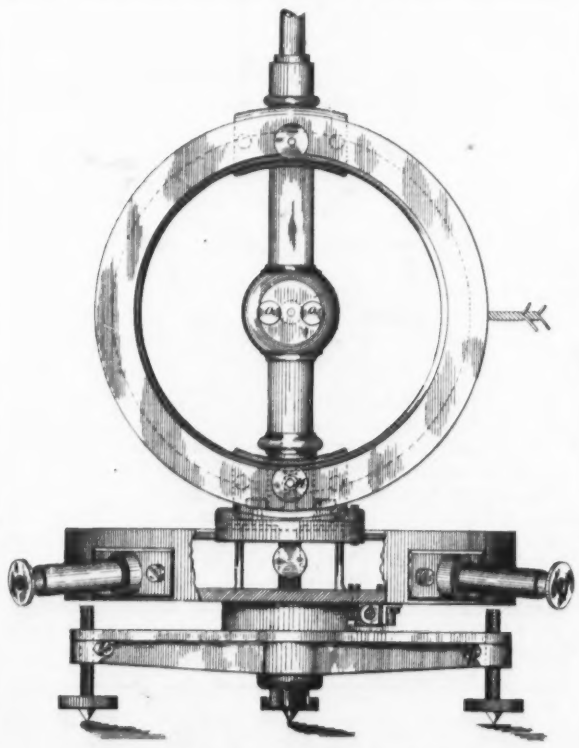
403,316. Device for Holding Telephones; Samuel J. Adams, of Detroit, Mich., Assignor of three-fourths to Monroe Rosenfeld, Jacob Brown and Arthur Brown, all of same place. Application filed March 13, 1889. In combination with a receiving telephone, a rod having on one end a clip to engage with the telephone, a pair of movable jaws adapted to engage with said rod, a swinging arm carrying said jaws, an arc and a locking dog at the pivotal end of the swinging arm, and a lever connected with said arm and adapted to simultaneously lock said arm and jaws.

403,345. Rheostat; John L. Gish, of Jackson, Mich., Application filed Jan. 16, 1889. The combination, with two resistance coils and their connections, of a movable contact point and a guide on which the contact point can be moved along each coil and from one coil to the other along their connection without breaking contact.

403,352. Coupling for Underground Conduits; Wilmot Lake, of Washington, D. C. Application filed Oct. 2, 1888. This coupling is rectangular in form, and is scored or grooved on the opposite sides, preferably in the same horizontal plane, so that when required for use it may be readily separated by the blow of a trowel or other instrument.

403,374. Electric Riveting Apparatus; Elias E. Ries, of Baltimore, Md. Application filed March 5, 1889. The invention consists of an anvil and a heading tool onstituting the terminals of an electric circuit which are bridged by the rivet itself during the operation. This rivet thereby becomes heated to any desired degree, which is controlled by the current regulator, so that the rivet is made plastic and may be maintained in that condition during the whole process of heading or during any part of the same, at the option of the operator.

403,397. Incandescent Lamp; James Stewart, of New York, N. Y., Assignor of one-half to Edmund C. Stanton, of same place. Application filed August 4, 1888. The invention consists in



403,312. PORTABLE TANGENT GALVANOMETER.

the combination with the carbon filaments and wires attached thereto, of a clamping device for holding the wires in contact with the conductors of the lamp socket.

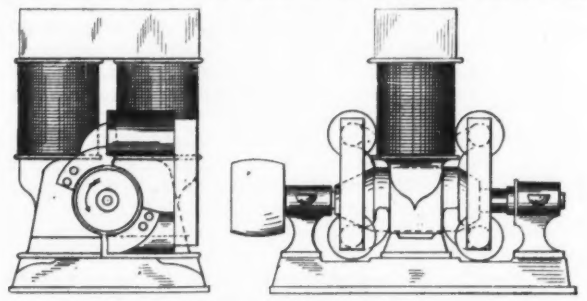
403,418. Method of Protecting the Lead-Pipe of Telegraph Cables from Corrosion; Arthur E. Colgate, New York, N. Y., Assignor to the Western Electric Company of Chicago, Ill. Application filed Feb. 2, 1889. The method of forming a coating of sulphide upon lead pipes, which consists in forcing sulphureted hydrogen into the conduit containing the lead covered cables.

403,429. Process of Electroplating Lead Pipes; Leonard D. Hosford of Brooklyn, N. Y. Application filed March 12, 1888. The process of making plumbers' pipes having an exterior coating of a denser and tougher metal, consisting in taking a lead pipe, rendering its exterior surface chemically clean by scouring it, immersing in a solution of caustic alkali, and afterward immersing it in a mercury dip and subsequently eletroplating the pipe in a bath consisting of a solution of the salt of the metal to be deposited.

(1) 403,439. Electric Controlling Device for Elevator Carriages; filed March 5, 1889. **(2) 403,441. Electric Controlling Device for Elevators;** filed March 7, 1889. **(3) 403,441. Electrically Controlled Elevator;** filed March 8, 1889. **(4) 403,442. Electric Controlling Mechanism for Elevators;** filed March 9, 1889. William E. Nickerson, of Cambridge, Mass. (1) In an electrically controlled elevator the combination of series of fixed cam-pieces of varying projections with electrical contact making and breaking levers adapted to be set by movable switch-blocks for automatic action, and movable switch-blocks (2) In an electrically controlled elevator the combination of contact plates within the carriage, connected to electric devices and adapted to move in relation to an index the same as the carriage moves in relation to the floors with an index electrode adapted to be set by the attendant. (3) In an electrically controlled elevator, the combination of a contact plate block arranged to move in unison with the movement of the elevator carriage and having contact plates each connected to one pole of an electric device, and having resting upon it electric contact points, each of which is connected electrically to switch-posts in the elevator carriage with an index electrode electrically connected with both electric devices and adapted to be set by the attendant. (4). The invention consists in placing upon the walls of an elevator-well switch plates in circuits and in connecting to the carriage an index-electrode to be operated by the attendant and to be so made and arranged that it can be set to cause a break in the circuit at any desired floor, so that the attendant can control the motion of the carriage by simply turning the index-electrode.

403,451. Electric Battery; John A. Barrett, of Brooklyn, N. Y., Assignor to the John A. Barrett Battery Company, of Baltimore, Md. Application filed Feb. 8, 1888. In a chloride of silver battery the combination, with a mass of fused chloride of silver having a conductor wire embedded therein, of a conductor applied to the surface of such mass and electrically connected with the embedded conductor. See illustration.

403,458. Multiple Switch Board Testing Apparatus; John J. Carty, of New York, N. Y., Assignor to the Western



403,158. DYNAMO-ELECTRIC MACHINE.

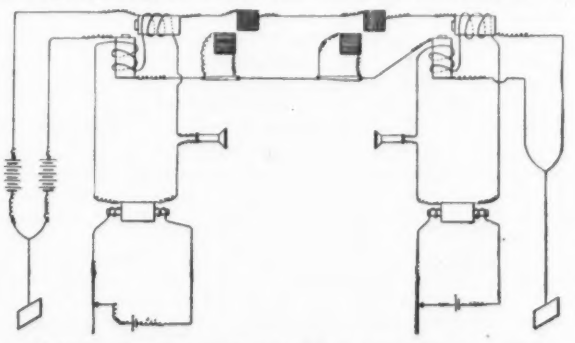
Electric Company, of Chicago, Ill. Application filed Feb. 2, 1889. A pair of loop plugs, the tips being connected together by a strand of a pair of cords, the sleeves of said plugs being connected together by another strand, which is connected through a rheotome, to ground, in combination with an operator's telephone, telephone lines and switching apparatus.

403,472. Printing Telegraphy; Zeroy P. Hotchkiss, of Oak Park, Ill., Assignor of one-fourth to Carlos J. Ward, of same place. Application filed Feb. 11, 1888. The invention relates to the printing in full of all words, figures and characters of a telegram while the same is being received through the instrument at the station to which the telegram is sent. It has for its object to print telegrams plainly after the manner of the type-writers now in use, to do this from the sender's station and to do it immediately, that is, to receive and print a telegram at the same time, turning it out of the machine ready for delivery.

403,482. Insulating Tubular Iron Posts; William H. O'Beirne, of Elgin, Ill., Assignor to the Star Iron Tower Company, of Fort Wayne, Ind. Application filed Dec. 3, 1888. An insulator for tubular posts, consisting of an insulator block, having oppositely turned ends and an intermediate annular flange, and a cup-shaped rain guard.

403,483. Testing Apparatus for Multiple Switch Boards; Joseph J. O'Connell, of Chicago, Ill., Assignor to the Western Electric Company, of same place. Application filed Oct. 22, 1888. The invention consists in providing a branch circuit to ground through a variable contact in connection with each pair of cords and testing apparatus for each operator at the different boards, consisting of a ground circuit, including a battery or telephone or other indicating apparatus, by means of which it may be determined, on closing the battery to the test piece of any switch upon one board, whether the line with which said switch is connected is busy.

403,487. Dynamo-Electric Machine; Frank A. Perret, of Brooklyn, N. Y., Assignor to the Electric Manufacturing Company, of New York. Application filed Dec. 29, 1888. In a dynamo electric machine, built up in layers of thin plates of sheet-iron, each plate constituting in one piece a pole-piece, a core, and part of the yoke, and pierced with bolt holes, in combination with



403,292. COMBINED TELEPHONY AND TELEGRAPHY.

bolts passing through all the layers and holding them together in rigid relation.

(1) 403,491. Insulating Device for Line Wires; (2) 403,492. Electro-Medical Apparatus; Thomas J. Smith, of Booklyn, N. Y., Assignor to The E. S. Greeley & Company, of Connecticut. Applications filed Feb. 19, 1889. (1) For description see E. W. March 30, 1889. (2) The invention relates to a novel arrangement of a battery and induction coil for electro-medical purposes.

PATENTS EXPIRED MAY 21, 1889.

127,000. Improvement in Apparatus for Lighting Gas by Electrical Spark; John Vansant, of San Francisco, Cal. The combination of a source of dynamic electricity, an automatic circuit breaker, a condenser, and a series of connected electro-magnetic primary coils, with a series of disconnected secondary induction coils.

127,041. Improvement in Fire-Alarm Signal Boxes; George Floyd, of Cincinnati, Ohio. An improvement in the details of fire-alarm boxes.

127,094. Improvement in Lightning Rods; John M. Mott, of Chicago, Ill. A lightning rod constructed with copper plate and galvanized wire twisted together.

127,111. Improvement in Printing-Telegraphs; John E. Smith, of New York, N. Y. A shunt applied to the escapement magnets of the type-wheel of a printing-telegraph for operation, so that, at the moment of printing, the current is diverted from said escapement magnets, thereby rendering the other magnet or magnets in the same main circuit more powerful.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patents issued since 1866—can be had for 25 cents. Give the date and number of patent desired, and address The W. J. Johnston Co. Ltd., Times Building, N. Y.